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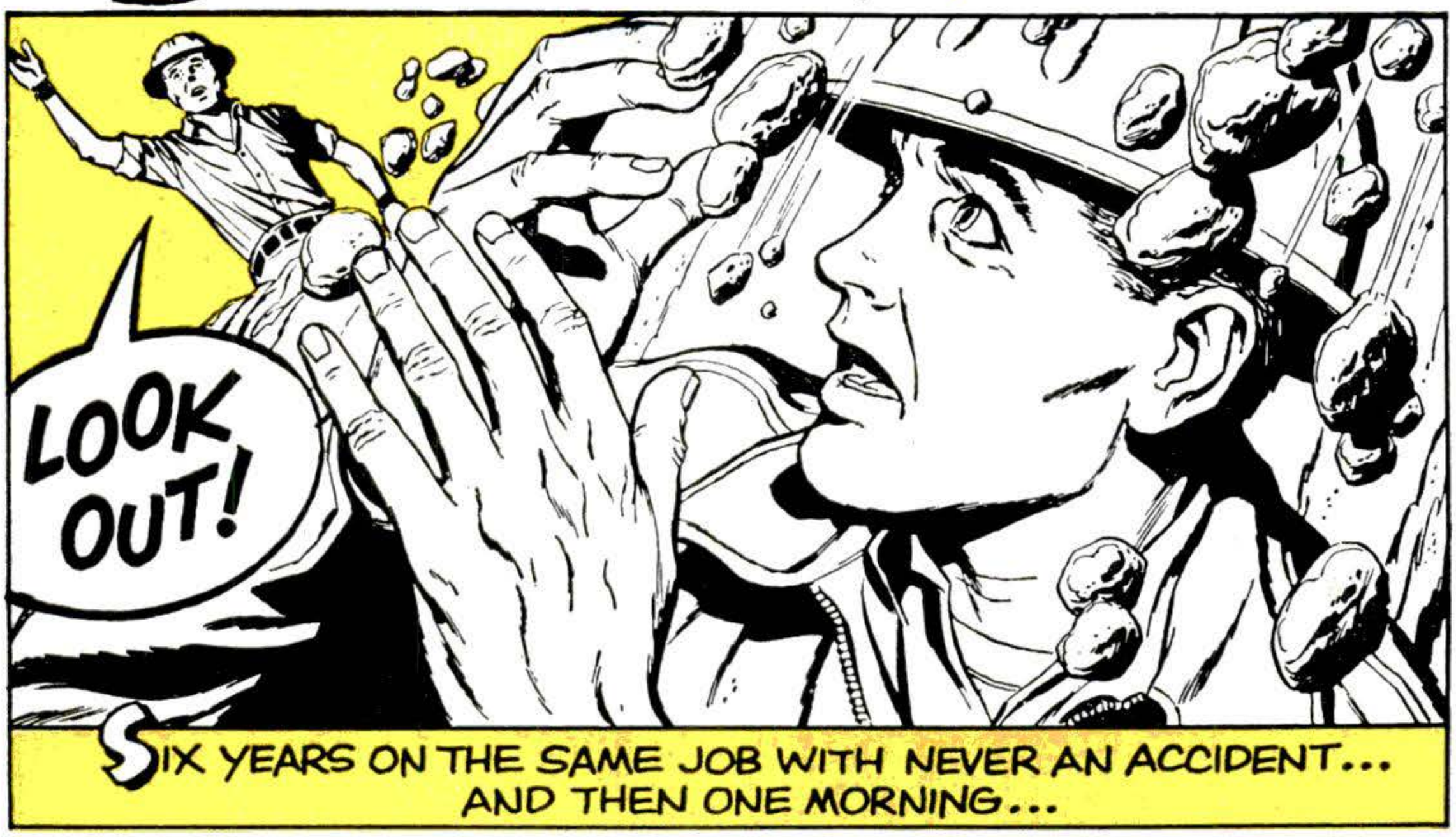

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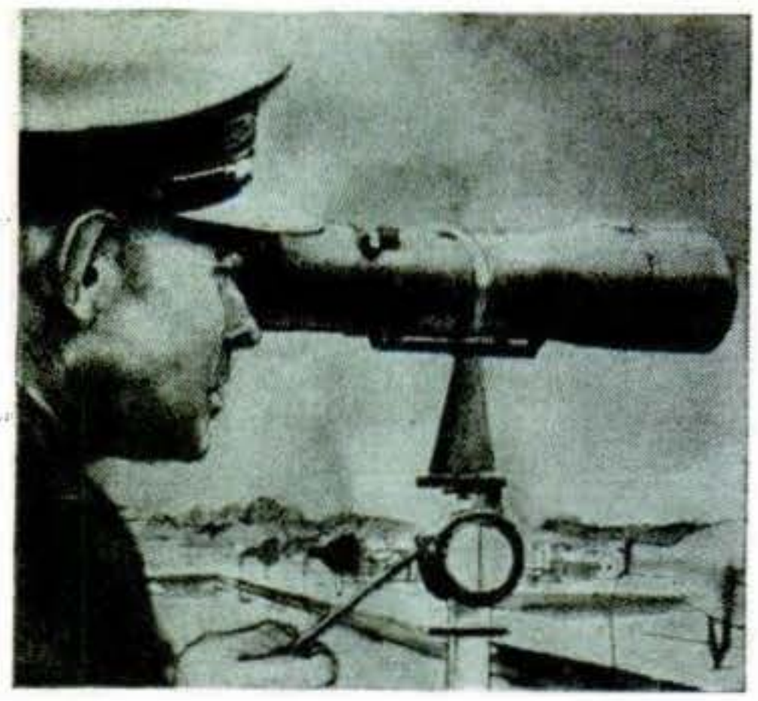

What's this man doing? Looking for spies. Here's the inside story of espionage in Detroit

Now U.S. scientists hope to rocket into space a see-all, know-all TV eye. Target date: any time . . . soon

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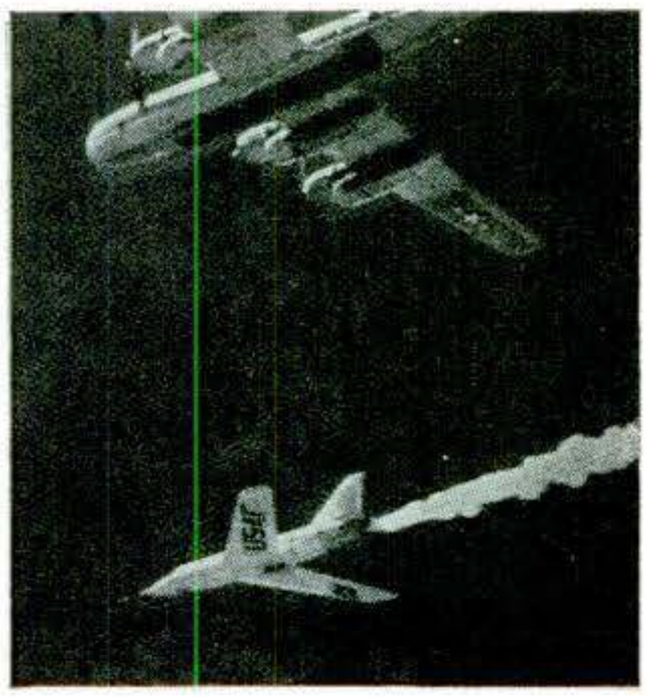

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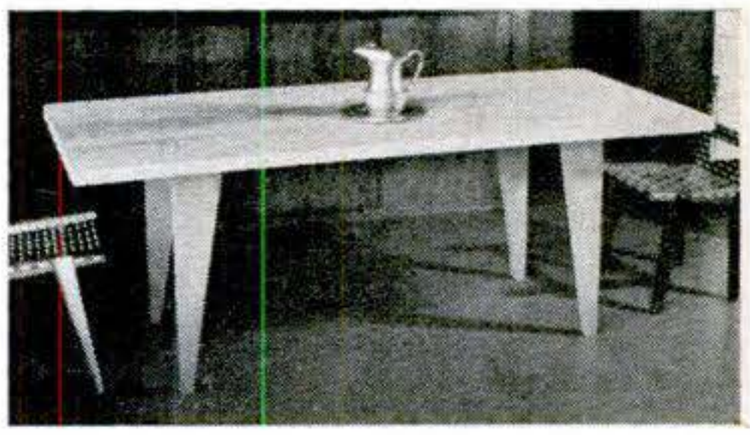

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PS Readers

TALK BACK

For Better Science Labs

YOUR article, "How Good Are the Science Labs in Your Youngster's School?" [Nov.], should be of assistance to schools and teachers who are trying to improve their lab facilities.

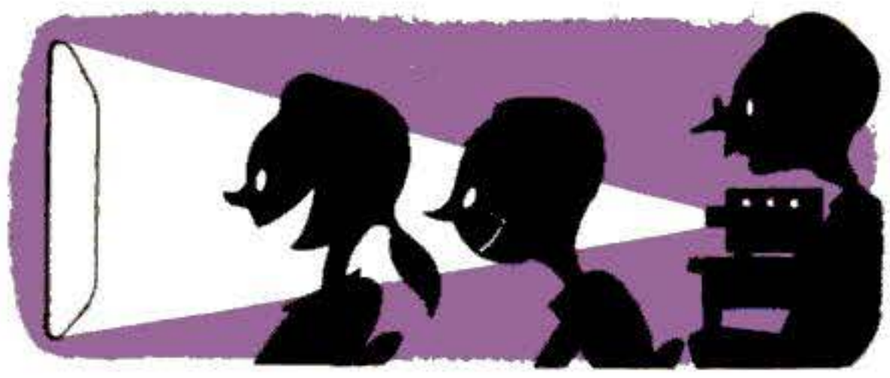
Since it is directed to parents, it should reach an important audience. It is well known that schools can have what their communities want them to have.

We are pleased that you saw fit to give space in POPULAR SCIENCE to this topic.

JOHN R. MAYOR, Director
Amer. Ass'n for the Advancement of Science, Washington, D. C.

. . . The lack of up-to-date science equipment in high schools, noted in your article, is obviously not going to be solved with one sweep of a wand.

But I wonder why science teachers have not made more use of film to teach



difficult concepts? Film strips can bring the equivalent of thousands of dollars' worth of apparatus into the classroom. Science educators should stop considering film strips a class respite or entertainment. Used side by side with textbooks, they can do a wonderful job of teaching science —without expensive equipment.

H. M. STONE, NYC

Running TV Chassis into the Ground

YOUR suggested safety check for TV sets, to insure that the neutral house wire goes to the chassis ["You Ought to Know," Oct.], was good, but I'd like to add a point.

The screw in the outlet cover is not always at ground potential. Often, in home wiring, the metal box, screw and plate are floating with no ground connec-

tion at all. This could lead a well-meaning but uninformed person into a feeling of security where none exists.

Most neon voltage testers will indicate the hot side by a glow when one tip is held in the fingers and the other is applied to the receptacle holes—and no harm will come to the person holding it.

L. D. BOYLES, Portland, Ore.

Good point. Metal outlet boxes should be grounded but often are not. Connect the tester between the chassis and a ground point that will make the neon glow brightly for one position of the plug. Then reverse the plug. *Leave the plug in the position that does* not *produce a glow. Even this method is not foolproof. Some sets will check okay when turned on, but check hot when turned off. The only solution here is to orient the plug properly when the set is on and pull the plug when it is off.*

Back-Seat Lament for '58 Car

THOSE gleaming '58 vehicles in your recent issues look good in four-color pictures, but brother, they don't feel so good. We just got home from a 2,000-mile jaunt in a friend's new car. Its owner (bemused by his privilege of paying $80 a month for 36 months) thought it behaved fine. My wife and I thought the old sedan in our garage at home—roomy, reliable and paid for—never seemed sweeter.

The '58s just don't make *any* sense. This convertible we rode in was about 18 feet long and had a trunk big enough to hold a spinet—but there wasn't enough room in the back seat for human beings over the age of 10. Some "sales engineer" had padded the instrument panel—but left untouched two lethal roof latches on

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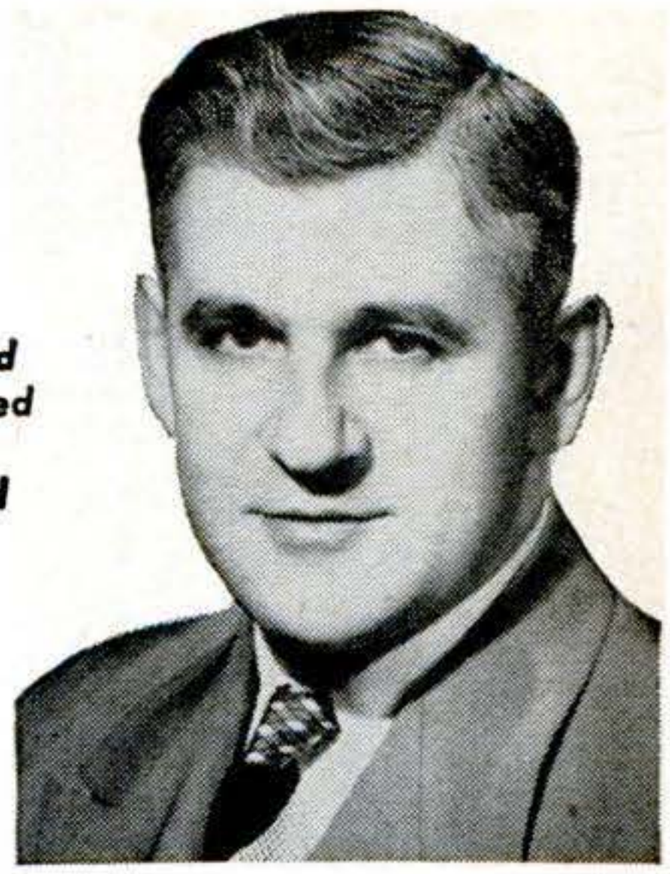

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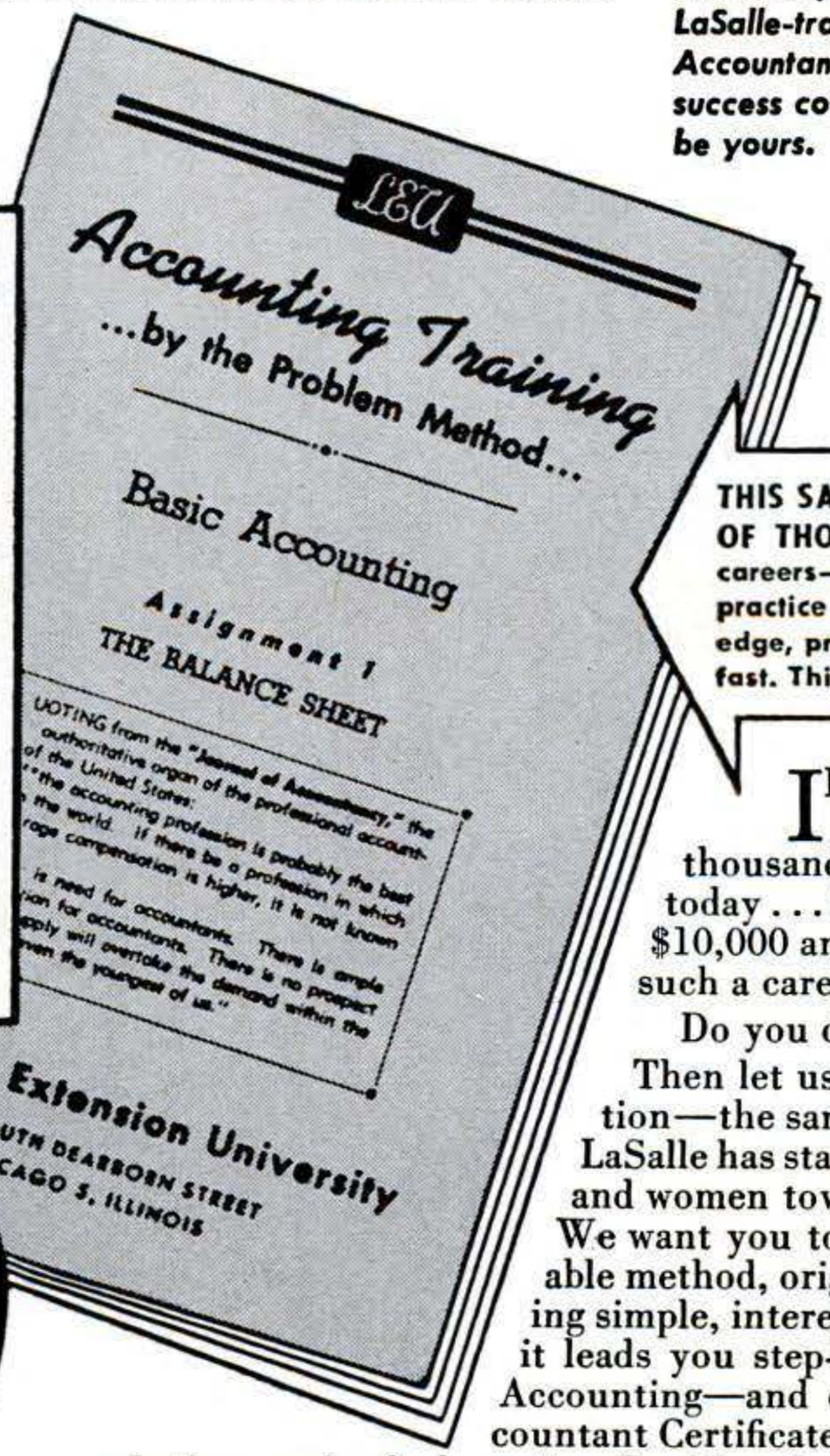

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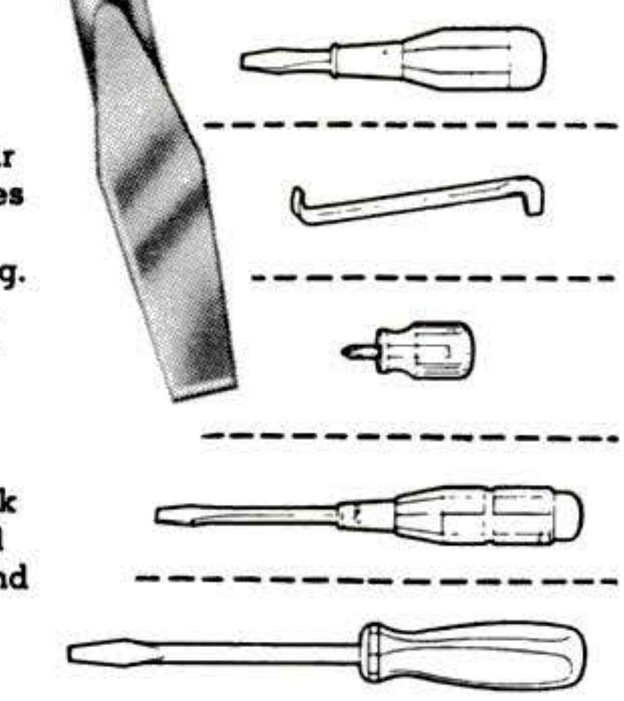

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the windshield header. And the bolt-studded steel top supports, by the rear seats, were just three inches away from your temples.

Acceleration was terrific—and so was brake fade. After parking, we found that getting out was no harder than escaping from a sunken sub, except that you didn't need a Momsen lung. Two tall, raked antennas sprouting from the rear deck made us look as if we were cruising offshore for

tuna. On the seat backs inside, on the stunning gold-and-silver metallic upholstery, were decorative enameled buttons the size of walnuts. These shortly produced identical-sized bruises on passengers' backs. This kind of idiocy can *only* be explained by my theory that a bunch of appearance-crazy designers have taken over in Detroit.

R. L. HALE JR., Lake Charles, La.

Gus Makes Problems in Far East

IN THE August Model Garage story, Gus speaks about a possible frozen wheel-cylinder piston, so it must be freezing cold. But the picture shows the men in summer clothes. Besides, the heat generated by the shorted stoplight would warm the cold master-cylinder housing.

Further, Gus says the shorted switch made the brake fluid boil. Then how could the pedal plunk to the floor without any effect? All four brakes would be blocked because of the expanding action of the boiling fluid. The brake pedal would certainly not plunk to the floor.

I have never met a case like this, and in my opinion one will never occur.

R. WOERISMAN
Keajoran, Indonesia

Please excuse Gus's use of Yankee trade lingo. To American mechanics, a "cocked and frozen" wheel-cylinder piston means a piston stuck in the cylinder for mechanical reasons, not one literally frozen by the outside temperature.

Air in a brake line will cause brake failure when compressed so that it doesn't transmit the full effort applied to the

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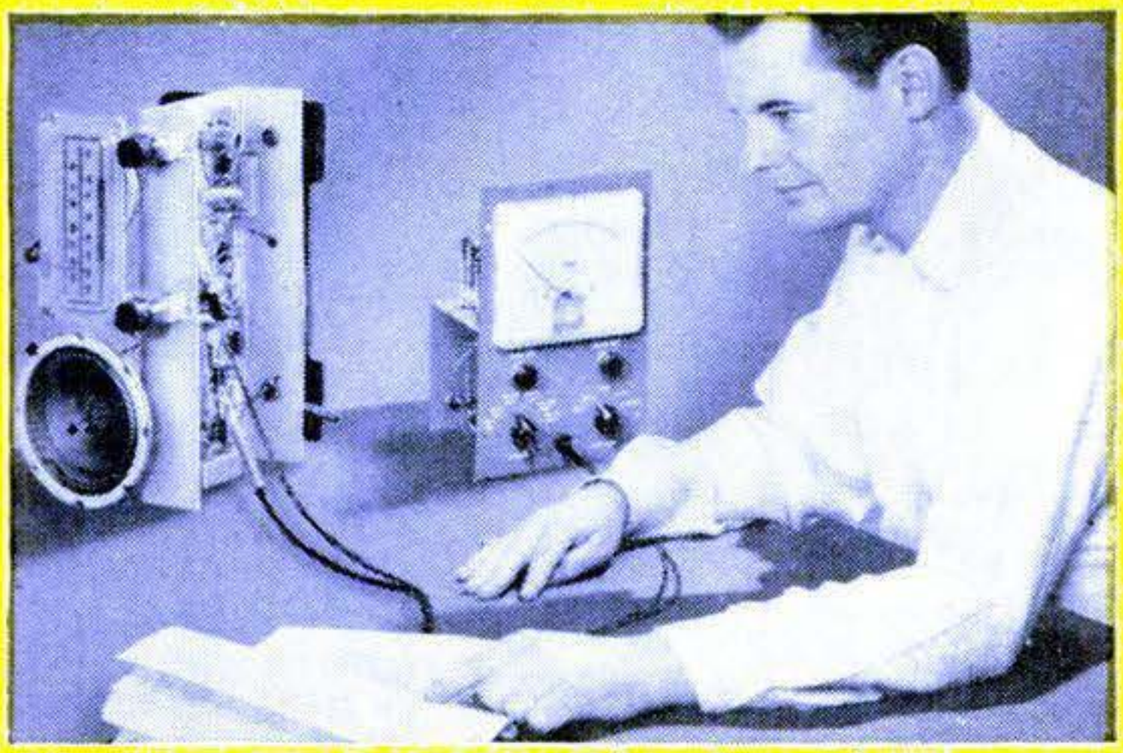

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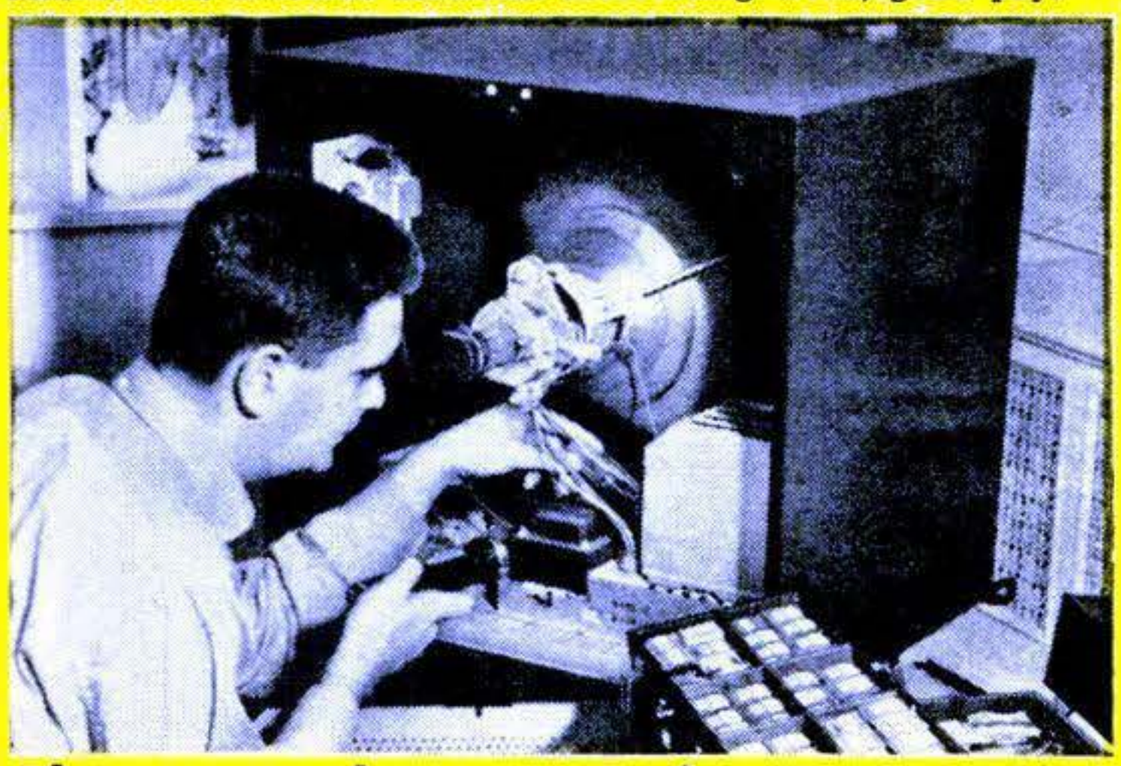

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J. E. Smith
Founder

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"Received my License and worked on ships. Now Chief Engineer Station WAPA. Grateful to N.R.I." R. D. ARNOLD, Rumford, R. I.

"Enrolled while meat market manager. Got serviceman job. In a year my pay increased 50%." C. CARTER, San Bernardino, Calif.

"Have a Radar job. Also do spare time Radio-TV servicing. Have my own amateur Radio station." F. ZAWAKE, Scranton, Penna.

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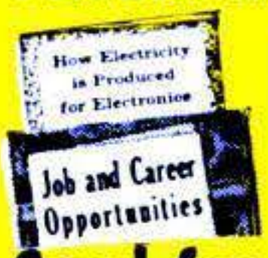

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brake pedal. Boiling brake fluid creates gas or vapor in brake lines, and this acts like air in reducing brake action.

PS Booklet Used as Textbook

YOUR booklet, "What to Do When Your Car Conks Out" [July], is proving to be a valuable aid to us in our auto shops. This is especially so in the light of our objective: to make the student a future intelligent user of the automobile. The well-illustrated articles in this pamphlet, dealing with the auto failures most frequently encountered, have served to stimulate the students in their work.

JOSEPH J. PORTLE, Principal
Washburn Voc. H. S., Chicago

Decimal Point Lowers Wow

SOMEHOW or other, in submitting the data on flutter and wow on our model 1960 recorder, we neglected to put a decimal point in front of the numeral three. Thus in your chart covering tape recorders [Nov.], instead of reading .3%, it appears as 3%. I do hope a correction can be made somewhere in your pages.

DAVID LIBSOHN, Telectrosonic Corp.,
Long Island City, N. Y.

Feeding the Free-Piston Engine

READING your article on the free-piston engine back in September raised a question in my mind that I've been unable to solve to this day. Can you help me?

In a conventional diesel engine, fuel must be injected in the proper amount at the precise moment. How is this accomplished in a diesel free-piston job when there is no positive mechanical movement to actuate the injector?

WILLIAM M. FULLER, San Antonio

Ford engineers explain: The fuel pump on their free-piston engine is driven by the oscillating synchronizing gear. (The engine has no rotating parts to drive the pump.) The synchronizing gear oscillates from standstill to maximum velocity at about midpoint of piston travel. At this maximum piston velocity, the injection pump feeds fuel to the fuel line. But the line is coiled and 15 feet long, so fuel delivery at the nozzles is delayed until at or near inner dead point of piston travel.

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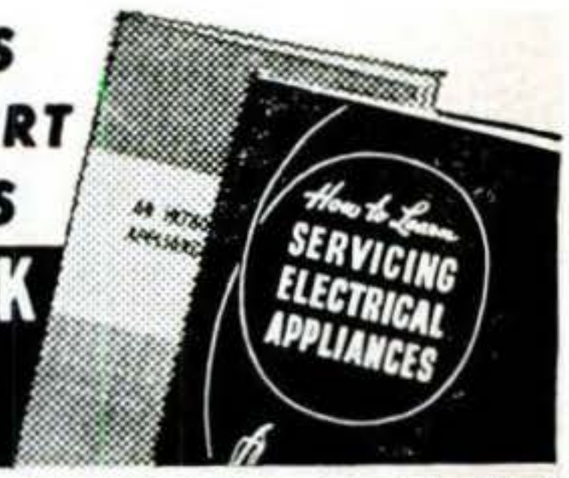

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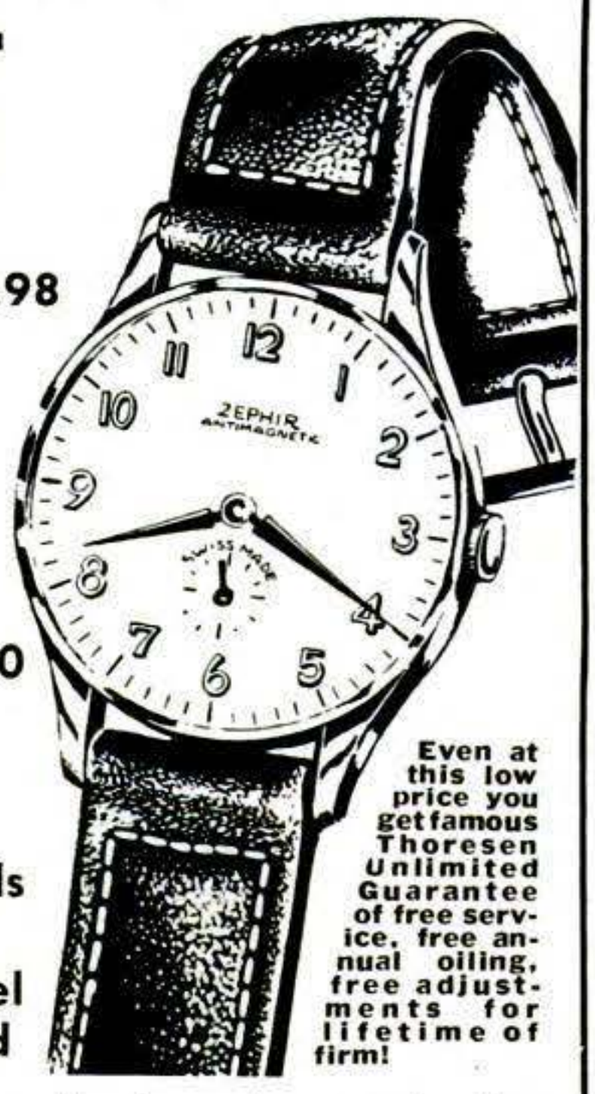

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The month in science

What price fuel economy? The faintly discernible trend toward more miles-per-gallon in U.S. cars could be reversed before it fairly gets moving. The reason, not strictly automotive: smog. Two classes of chemicals in auto exhaust are a major cause of smog: oxides of nitrogen, and unburned hydrocarbons.

GM researchers have now figured out one way to eliminate the nitrogen oxides—at least on new, top-tuned cars. Reset the carburetor to run rich all the time—at a loss of 26 percent in fuel economy.

Today's carbs, remarkably parsimonious with gas, are linked to the gas pedal to give a rich mixture (12:1 air-fuel ratio) for maximum power while accelerating, then lean out (16:1) for maximum economy at cruising. It's the economical cruise setting that causes the trouble: Nitrogen oxide formation hits a peak.

Road tests with a rich carb (11:1) showed these results:

- Driveability not affected.
- Nitrogen oxide reduced 90 percent overall, even more during part-throttle acceleration and 40-50-m.p.h. cruising, which produce the greatest amount of these gases.
- Gas mileage cut an average of 4.1 m.p.g. This adds about $70 a year to the fuel bill.
- Carbon monoxide output increased.
- Hydrocarbon output increased for some driving conditions, decreased for others. No clear-cut difference overall.

One problem they did not check on was maintenance. Will the rich mixture gum up the fuel-intake system, shorten valve and plug life? Another: How about older, detuned cars?

The GM research suggests these steps for a sweet exhaust:

- A compromise carburetor set at 12:1, eliminating 75 percent of nitrogen oxides while boosting your fuel bill $40 a year.
- Catalysts, in the muffler or inside the cylinders themselves, to burn off hydrocarbons and carbon monoxide.
- Super-premium fuels, which generate less smog but again add to your gasoline costs.

Still unanswered: Can U.S. motorists be persuaded—by social pressure or legal fiat—to pay for the accessories and inefficient operation that a clean atmosphere requires?

Too much radiation. Scientists' increasing concern about harmful effects of atomic rays has now brought government action, as PS forecast last December (p. 21).

AEC lowered the boom on permissible radiation to its employees, to people living near atomic plants, and—for the first time—to the population as a whole.

The reduction was drastic: 67 percent. Atom workers will now be permitted an average of no more than approximately five

The month in science

roentgens a year (old limit: 15R.). Maximum exposure of other people was set at one-tenth that of atom workers.

And another step: Cut down on chest X rays to spot tuberculosis.

The U.S. Public Health Service recommended that health agencies stop mass programs intended to X ray everybody, use X rays only on people likely to have the disease.

For your next house: plastic plumbing. It's a good bet with a new type of plastic just now coming on the market.

Name: polypropylene. It looks and feels pretty much like polyethylene (the stuff used for squeeze bottles). The big thing is its heat resistance. It can stand boiling water, could easily handle a home hot-water supply—something polyethylene can't do.

Polypropylene results from a smashing breakthrough in the science of atom-juggling. Giulio Natta of the Milan Polytechnic Institute discovered catalysts that produce orderly (as opposed to random) long chains of molecules. The molecules join together, end-to-end, with their side branches lined up, all of one type on one side, all of another type on the other side. This orderliness is what makes the difference.

Polypropylene promises big things, beyond plumbing pipes. It is somewhat lighter, stronger and more rigid than polyethylene. It's cheap, made from propylene gas, a petroleum by-product. You'll see it as housewares, machine parts, fabrics, films.

Today's only polypropylene maker: Montecatini, Italian chemical combine that underwrote Professor Natta's research. But Hercules Powder has just begun work on a plant here.

Eddy currents in the kitchen. Latest switch in the continuing effort to electrify the cook is a really different kind of stove that has no heated elements, makes the pots heat themselves.

It works on eddy currents. A motor spins a magnetized wheel under the stove's surface. This creates a changing magnetic field which induces electricity in ordinary metal pots. Eddy currents are converted to heat by the resistance of the metal.

The new system claims impressive advantages:

- It cooks twice as fast as a standard electric range.
- The stove itself stays cool, which means that spills don't get baked on, are easily wiped off.
- Kitchen is cooler because practically all heat goes into food.
- Cooking unit can also power a mixer-blender—a glass jar containing a magnetic rotor agitated by the magnetic field.

Don't expect to buy one for a couple of years. Tuttle & Kift, Chicago stove-component manufacturer, just imported the invention (from Germany), is now trying to sell it to range makers.

Martin Mann

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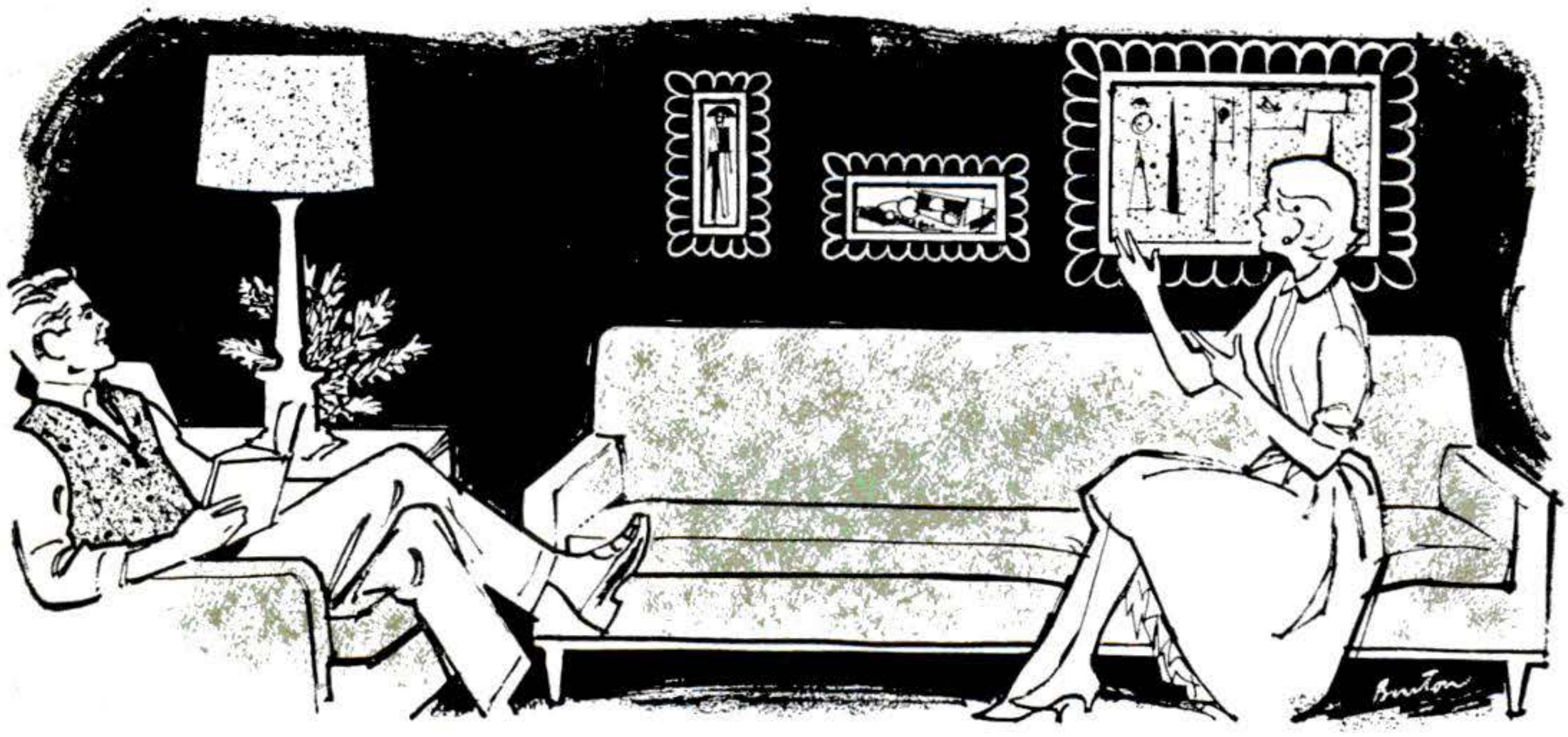
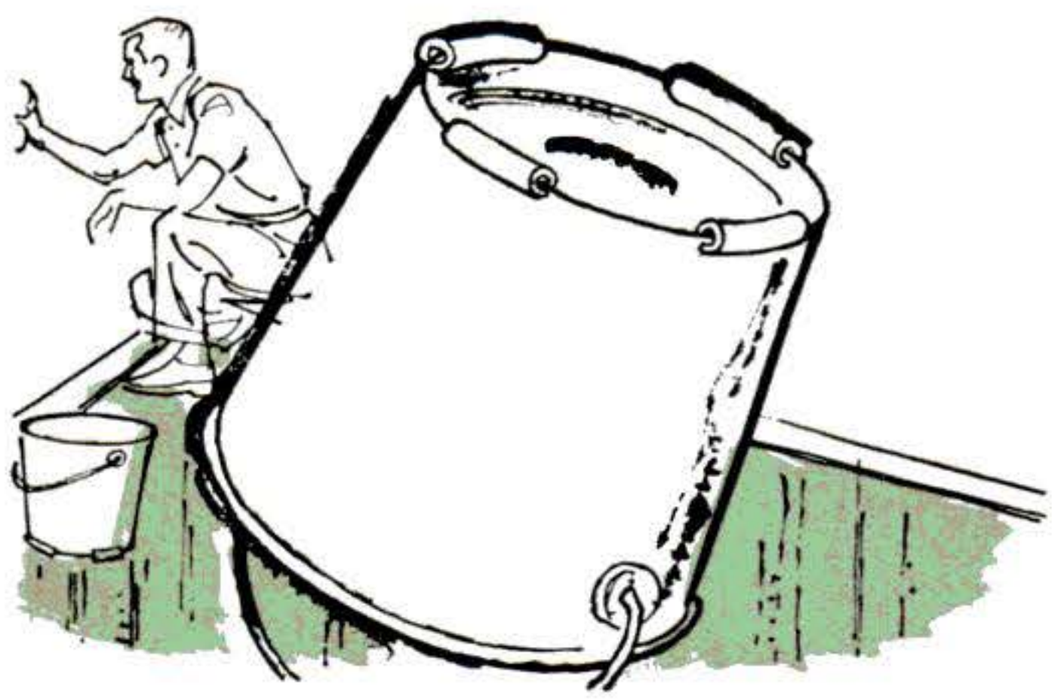
Keeping the Home Shipshape

KEEP A DOOR FROM SWINGING SHUT when you don't want it to. Remove one of the hinge pins and pound it lightly to bend it a bit. When replaced, it will hold the door in any position.

YOU CAN MAKE A DUSTPAN RACK from two wooden clothespins sawed in two as shown. Drill the stepped pieces to take a screw and brad, and mount them on a closet wall or door.



TO MAKE A SMALL FRAME LOOK BIG, tack loops of stiff twine all around its edge at the rear. Then cover both the frame and twine with white paint, and fleck with gold accents.



PROTECT TILE FLOORS from being marred by the sharp bottom rim of a scrub pail. Four pieces of slit tubing attached to the protruding edge with rubber gasket cement will cushion it.

TO SEAL A PLASTIC BAG full of dry cereal or potato chips tightly, twist a pipe cleaner around its neck. The cleaner is easy to remove and can be re-used many times for resealing the bag.

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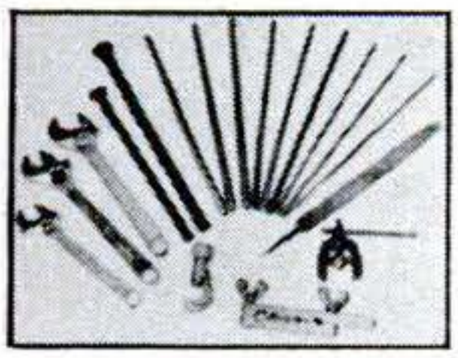

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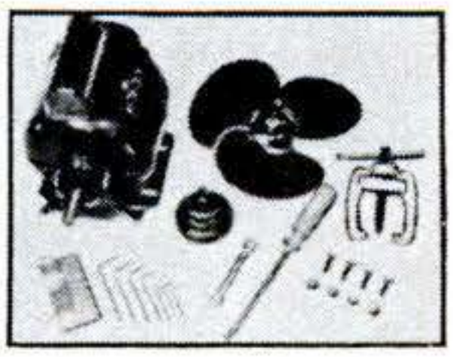

In another kit (right) you get motor, fan, pulley, service tools. Kits develop skill, let you get experience, eliminate years of low-pay apprenticeship.

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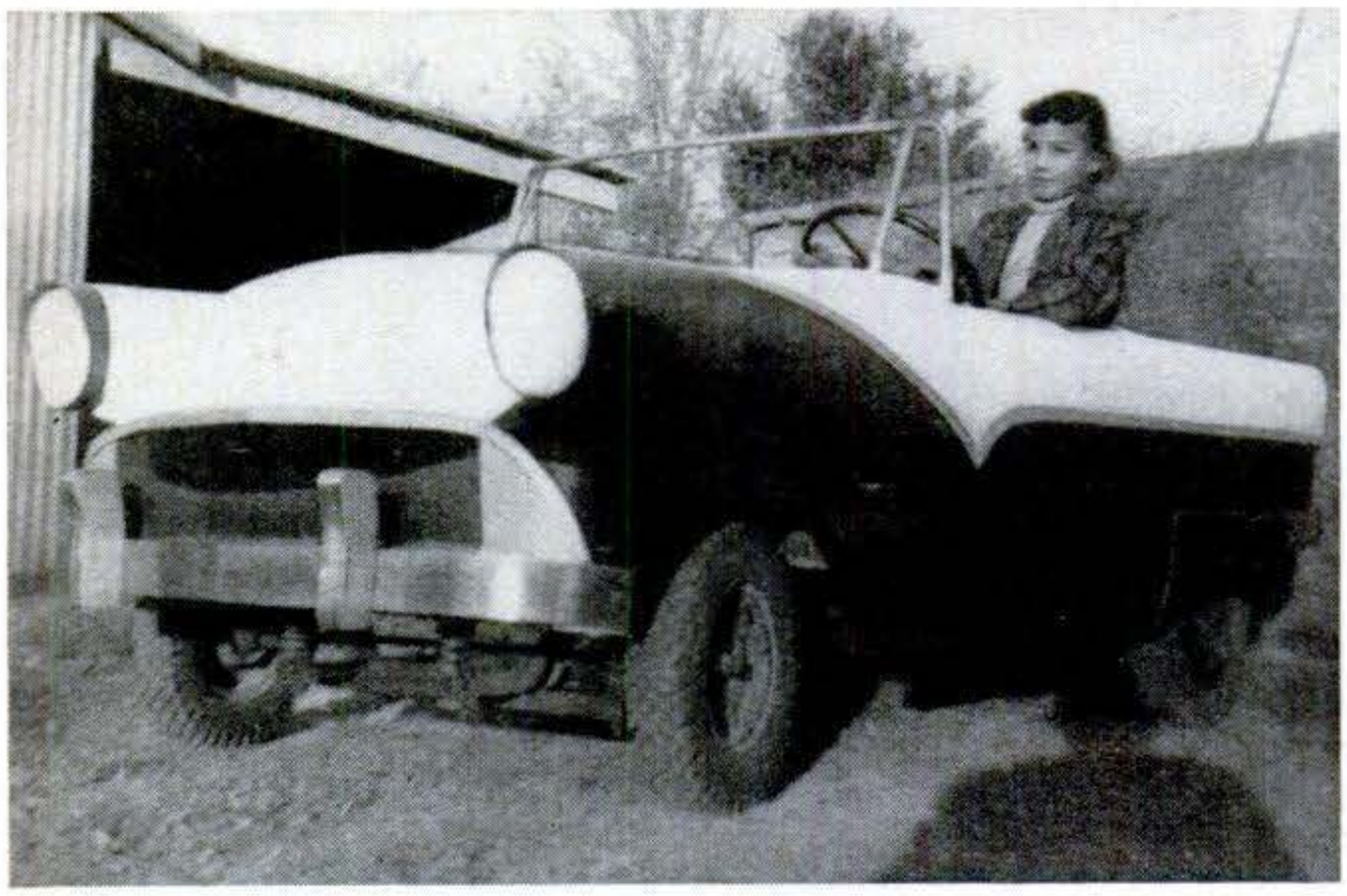

Mixed-Up Car. A two-hp. lawn-mower motor in the rear powers this little car that Alvis A. Lee of Prairie View, Tex., built for his daughters. Wheels and the driving mechanism came from an industrial mower, and the body is galvanized sheet iron over a wood frame. The only auto parts are a Crosley steering wheel and truck reflectors used as tail lamps. With the chassis, running gear and body constructed from backyard scrap, cost of the car was less than $75.

Door Stop. This miniature chair, styled after Duncan Phyfe, has a two-pound lead weight under the seat to give it heft. John G. Lownsbery of Richmond, Va., made it of solid Honduras mahogany assembled with dowel joints. The strings of the lyre at the back are $\frac{1}{16}''$ copper-coated welding rod, polished and lacquered. Blue velvet was used to upholster the seat of this ingenious and handy little job.

Desk and Chair. When farmer Arthur E. Ader of Rolfe, Iowa, sits down to his correspondence, he uses home-grown furniture. He built the desk and chair of solid walnut from trees cut on a neighbor's land. The job involved assembling and gluing 114 pieces of wood. The desk top is made up of three boards, doweled and glued. Ader also made his own shaper for edging the desk top.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to the Mechanics and Handicraft Editor, POPULAR SCIENCE, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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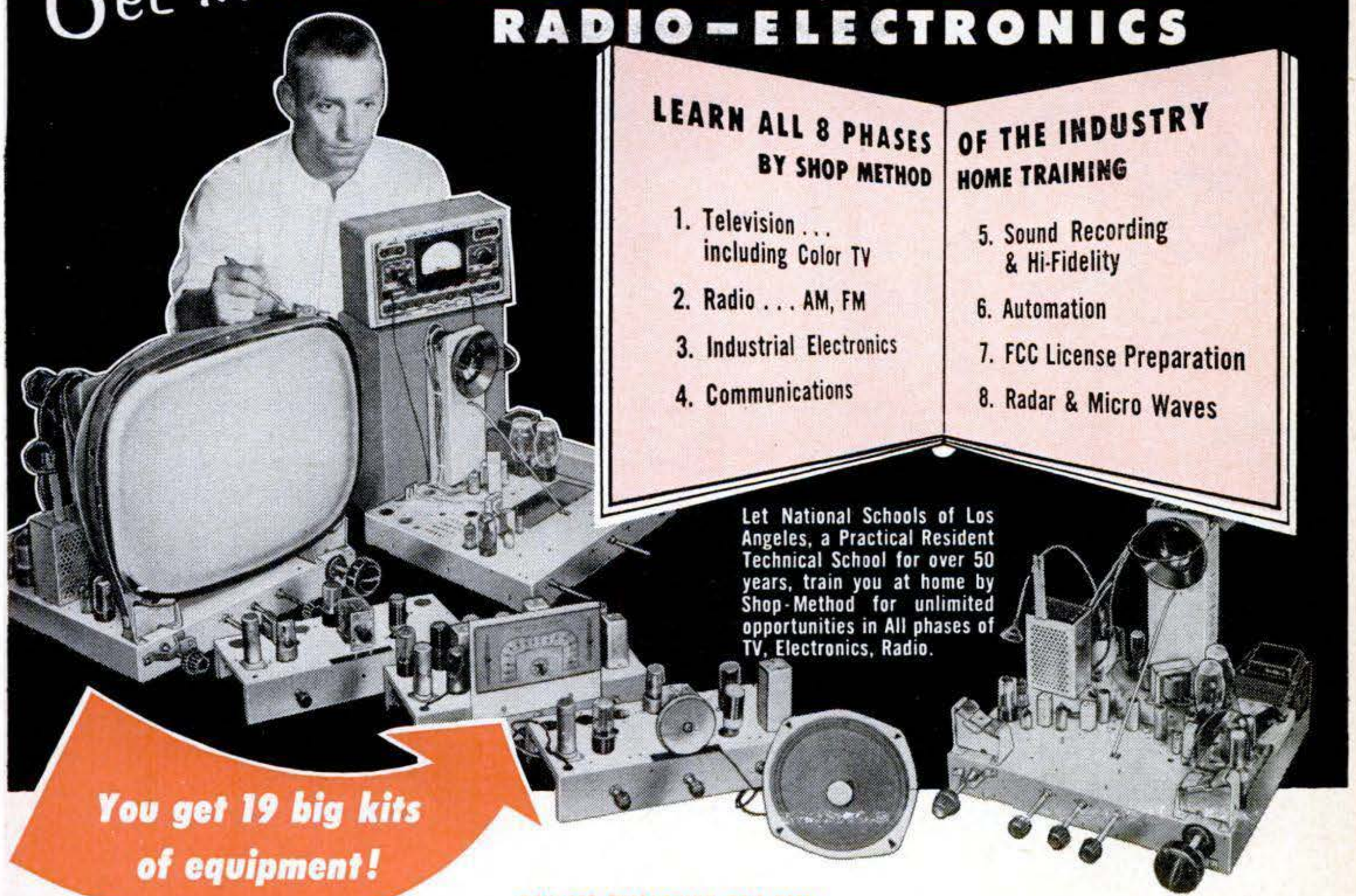

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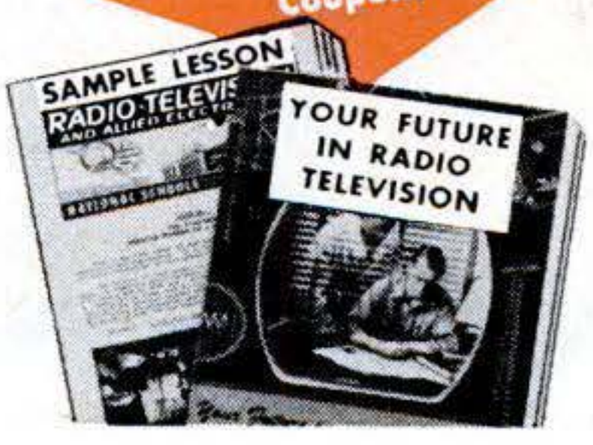

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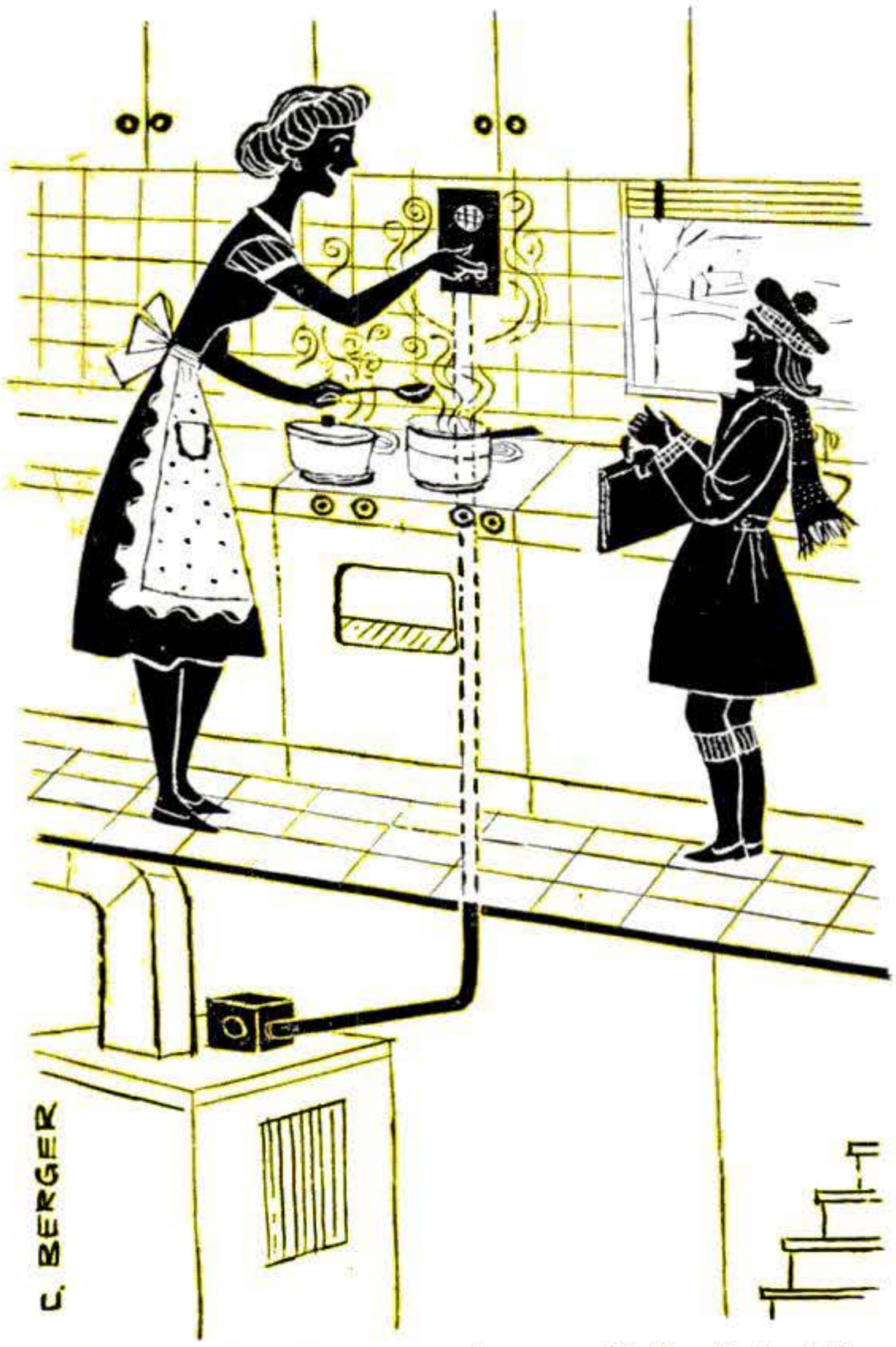
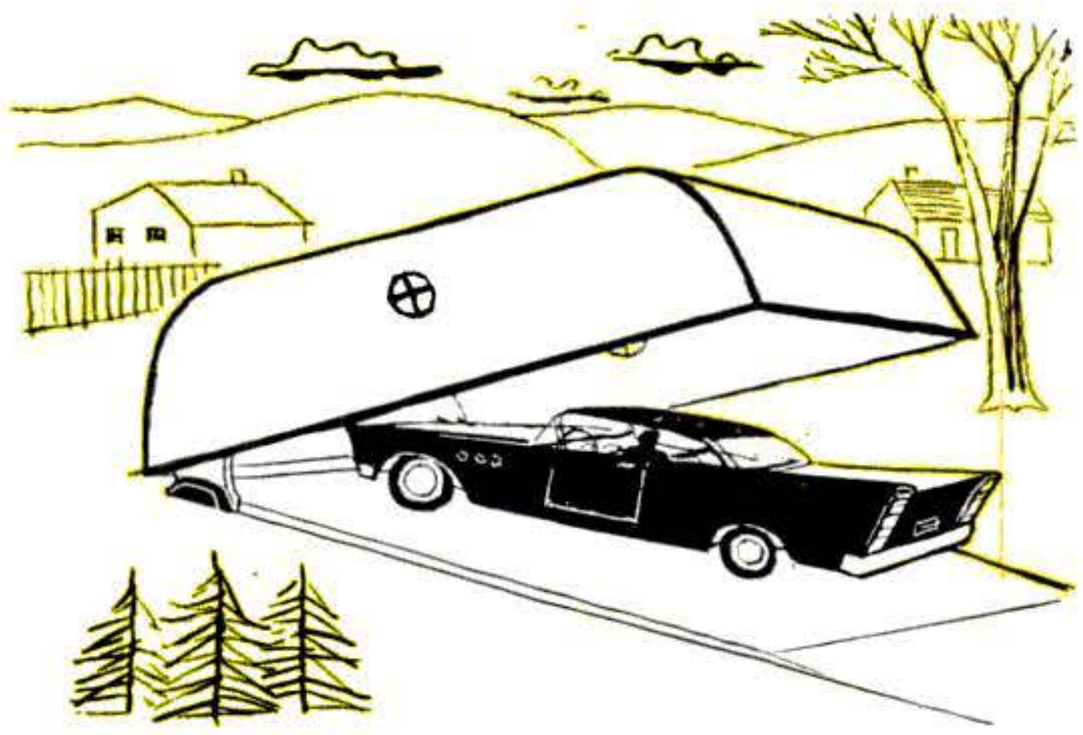


KITCHEN DEODORIZERS that could be linked by tubing to forced-air furnaces. They would quickly eliminate cooking odors in winter when windows are shut.—*Fred Purnell, Lombard, Ill.*

A JACK PLANE WITH AN EXTENSION at one side. By sliding the extension along the face of a board, you could keep the edge square while you planed it.—*Donald Snyder, Canton, Ohio.*

A VACUUM-BOTTLE ADAPTER to make it a baby's bottle for use at drive-in movies or on car trips. No need to heat the milk—just slip on the nipple.—*S. Abramczyk, Wyandotte, Mich.*

PULL-OUT DOME LIGHTS on cars. A long reel-wound cord would allow the lamp and housing to be removed for use as a trouble light outside the car.—*Robert Current, Fort Wayne, Ind.*



A ONE-PIECE PLASTIC GARAGE that would swing open or closed, like a clamshell, on a spring-and-hinge mechanism anchored in the concrete-slab base.—*Ralph Westervelt, Newark, N. J.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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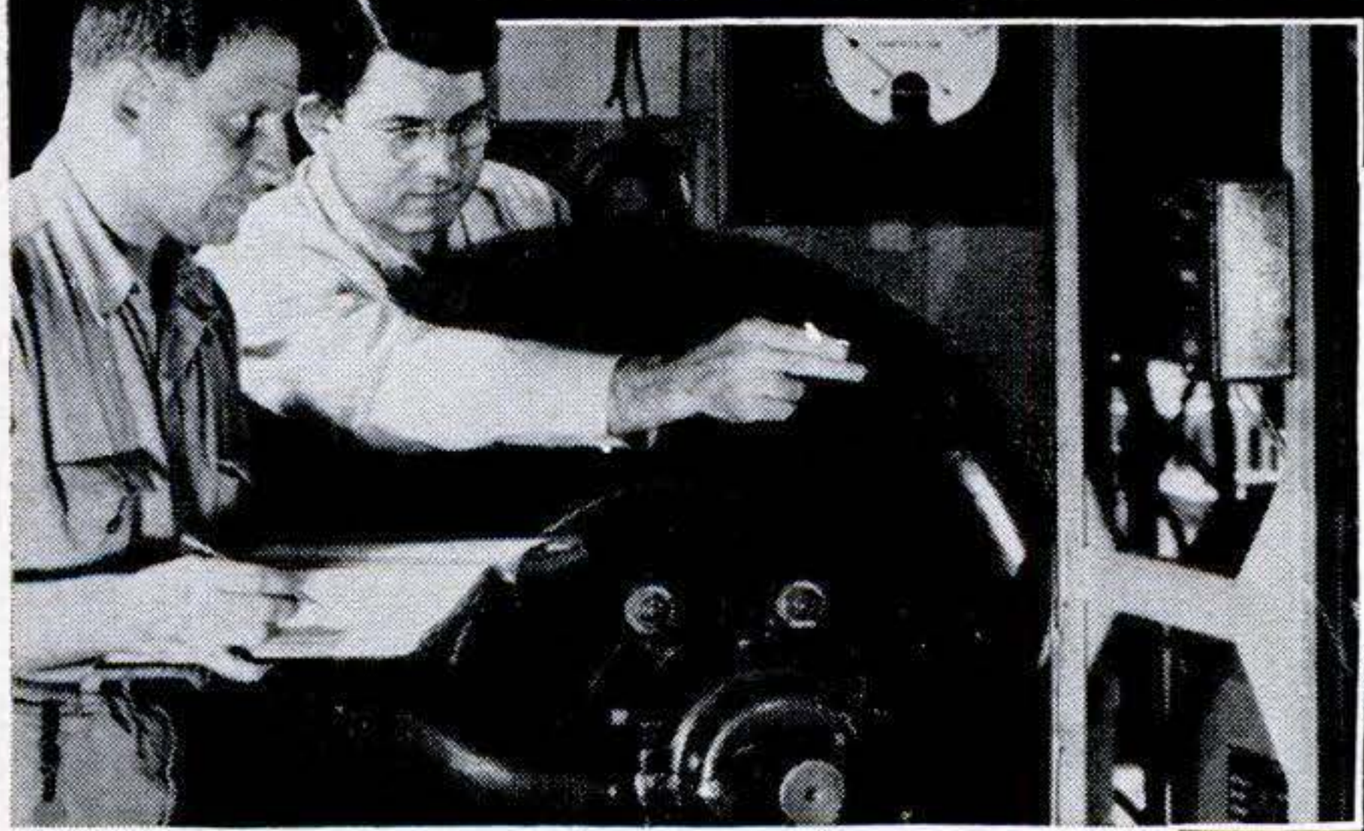

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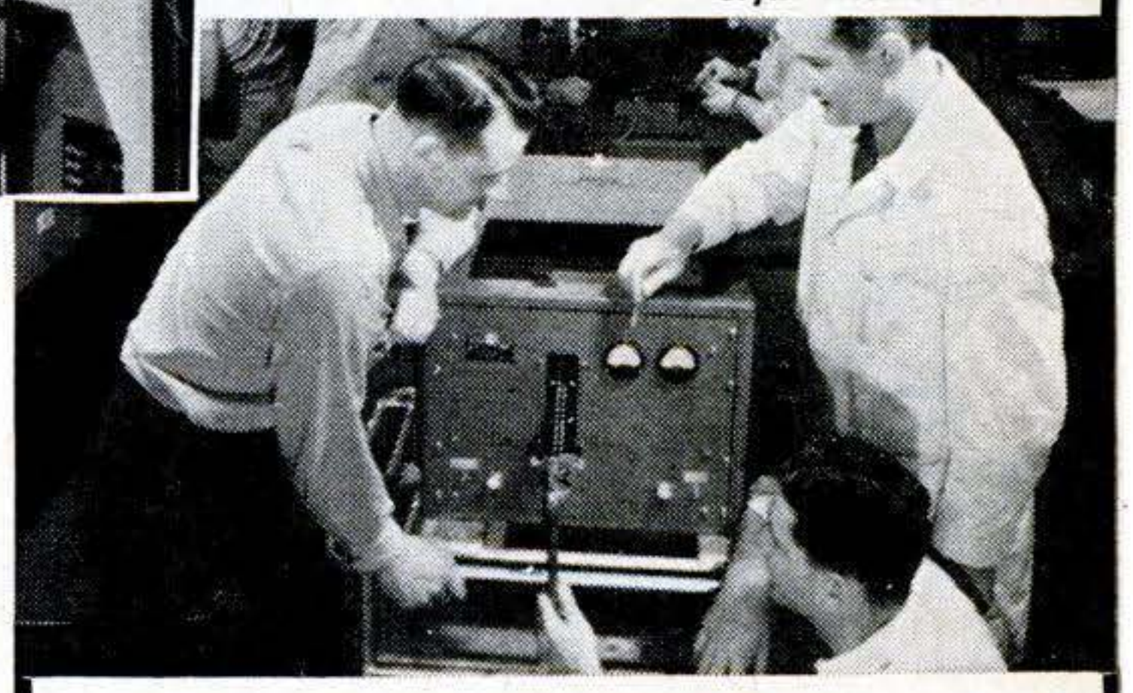

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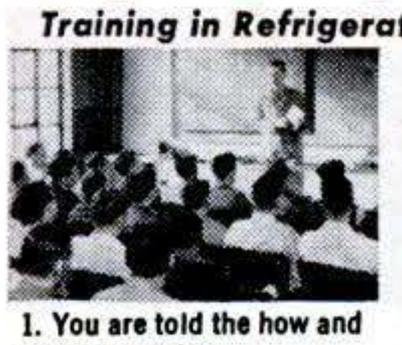

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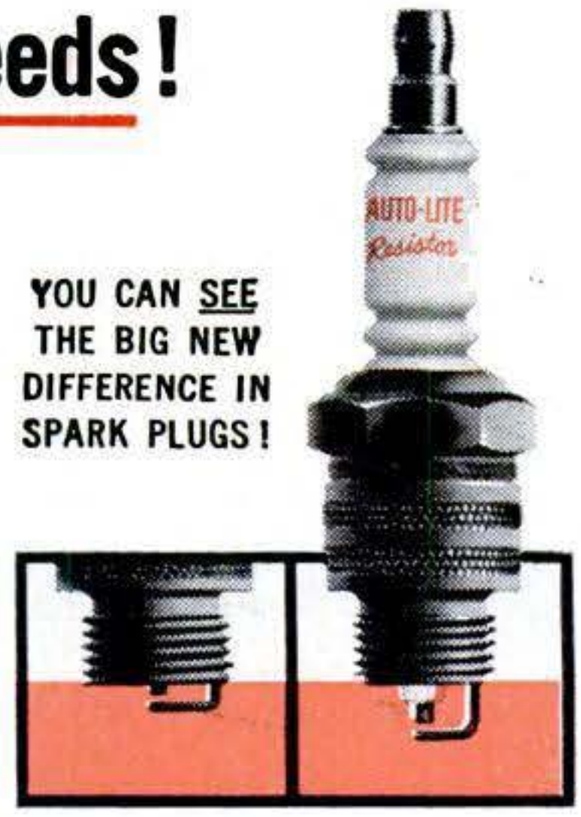

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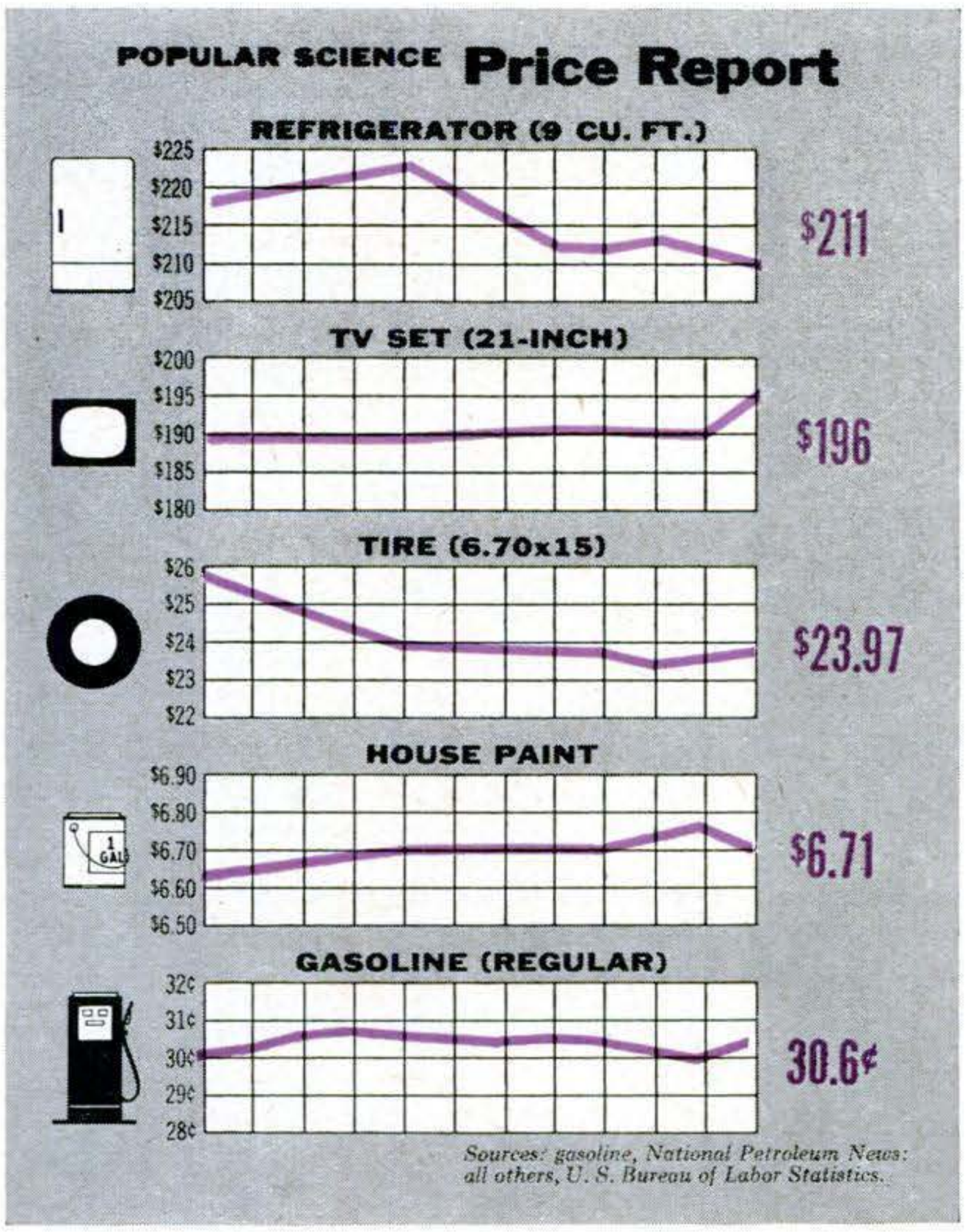
Solid price information—at last. Every month in this space PS will report on actual retail prices—the data, never before available, you need for smart shopping.

How much should you pay for a TV set . . . tires . . . paint . . . refrigerator . . . gasoline? List price doesn't mean much. Advertised price is often bait. To get the most for your money you want to know the going market price—what buyers are actually paying.



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The figures are average retail selling prices. collected every month in the five largest U.S. cities (New York, Chicago, Los Angeles, Detroit, Philadelphia) by a corps of professional shoppers. They're accurate. The gas prices are supplied by the staff of "National Petroleum News," a McGraw-Hill trade journal. The other four come from the Bureau of Labor Statistics, the Government agency that compiles hundreds of prices to compute the official Consumer Price Index (the figure used to adjust wages of some 3,000,000 workers). All PR prices include federal taxes, but *not* local sales taxes.

Which commodities? They're the ones you want to know about:

- Gas—regular grade.
- Paint—first-quality, exterior white (not trim), one-gallon lots.
- Tires—tube-type 6.70 x 15, four-ply, standard grade. Mounting charge is included, trade-in on old tire deducted.
- TV sets—21-inch standard table models using 15 to 18 tubes.
- Refrigerator—8.8 to 9.7 cubic feet; across-the-top freezer chest.

How to use the Price Report: Remember, these figures are aver-

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You ought to know...

ages. Some stores charge more, others less. Consider the PR quotation as a starting point. You shouldn't have to pay much above it; you'll do still better by shrewd shopping.

Watch the trends. Each month we'll show a whole year's prices, month by month. If the curve is climbing but you're going to need to buy soon, buy now. If it leans downhill and the purchase is postponable, wait a while. We'll give you tips on this point, so that you can plan ahead (the Price Report quotes latest available figures, which necessarily are some weeks dated).

Watch the seasons. Tires, gas, paint run higher in spring and summer. Appliances jump right after new models come in (look what happened to TV sets last fall). The curve highlights seasonal quirks. We'll call your attention to them, forecast changes.

Know your area. The Price Report is a national average, representative of the whole U.S.A. But localities may differ. Detroit is high on gas (1¢), tires ($1), TV ($15). Chicago is high on paint (12¢), refrigerators ($16). We'll keep you posted on this, too.

Right now, watch these prices:

- Lumber could swing up. Housing starts have been down, so you can get good buys in two-by-fours, planks, boards, sheathing plywood (see Jan., p. 21). But residential building jumped 11 percent in October (over October, 1956). The bargains may fade.
- 1958 appliances all carried higher price tags. And now Hotpoint predicts another price hike early this year.
- Hard-surface floor and wall coverings are scheduled to go up as much as five percent.

How dangerous are loose auto nuts? Startling evidence shows that they—the mechanical fasteners, not the drivers in cars—are a major source of highway accidents. It comes from a survey of over 500 state inspection-station examiners conducted by New Jersey's Division of Motor Vehicles.

The division wanted to find out when so-called mechanical failures are really fastener failures. There are around 800 mated parts on an average auto. Most of the joints use some kind of lock washer to counteract strain and vibration.

Is a shaky fastener very dangerous? Nearly all the New Jersey examiners said "Yes!" After thumbing through their records, they came up with a total of 1,262 smash-ups caused by lost fasteners. No one part of a car was more dangerous than the others. Fastener failures in brakes, wheels, steering controls, drive shafts, axles and other parts all contribute to accidents. Danger spot: generally speaking, any place in a car where a lock washer is used to hold a nut and bolt together.

The American Association of Motor Vehicle Administrators has urged Detroit to give the problem serious consideration.

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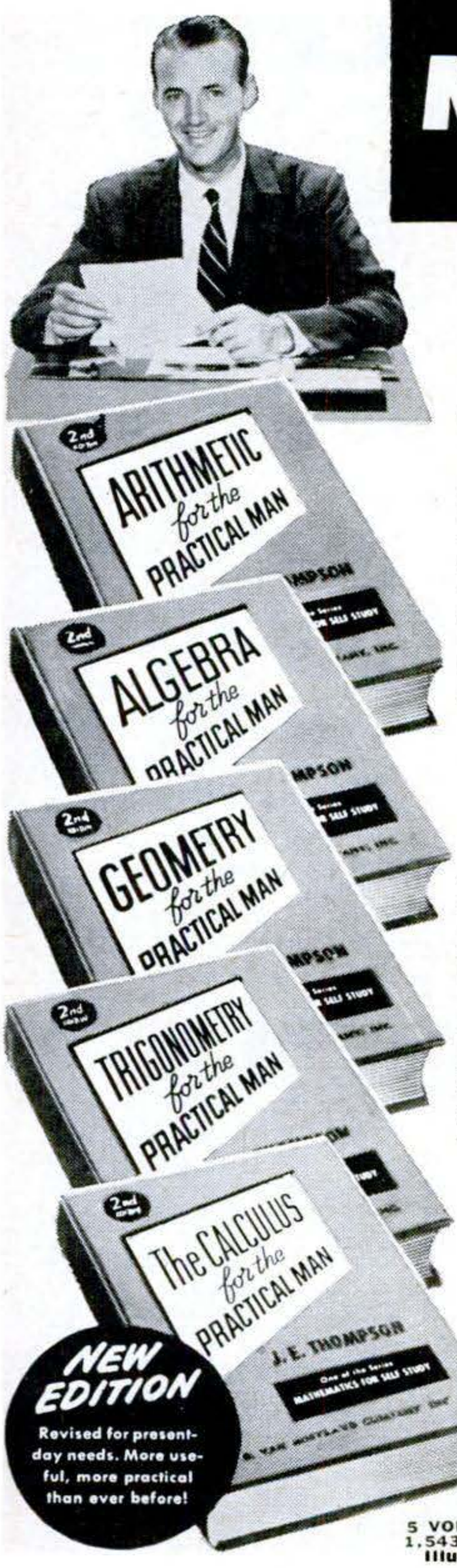

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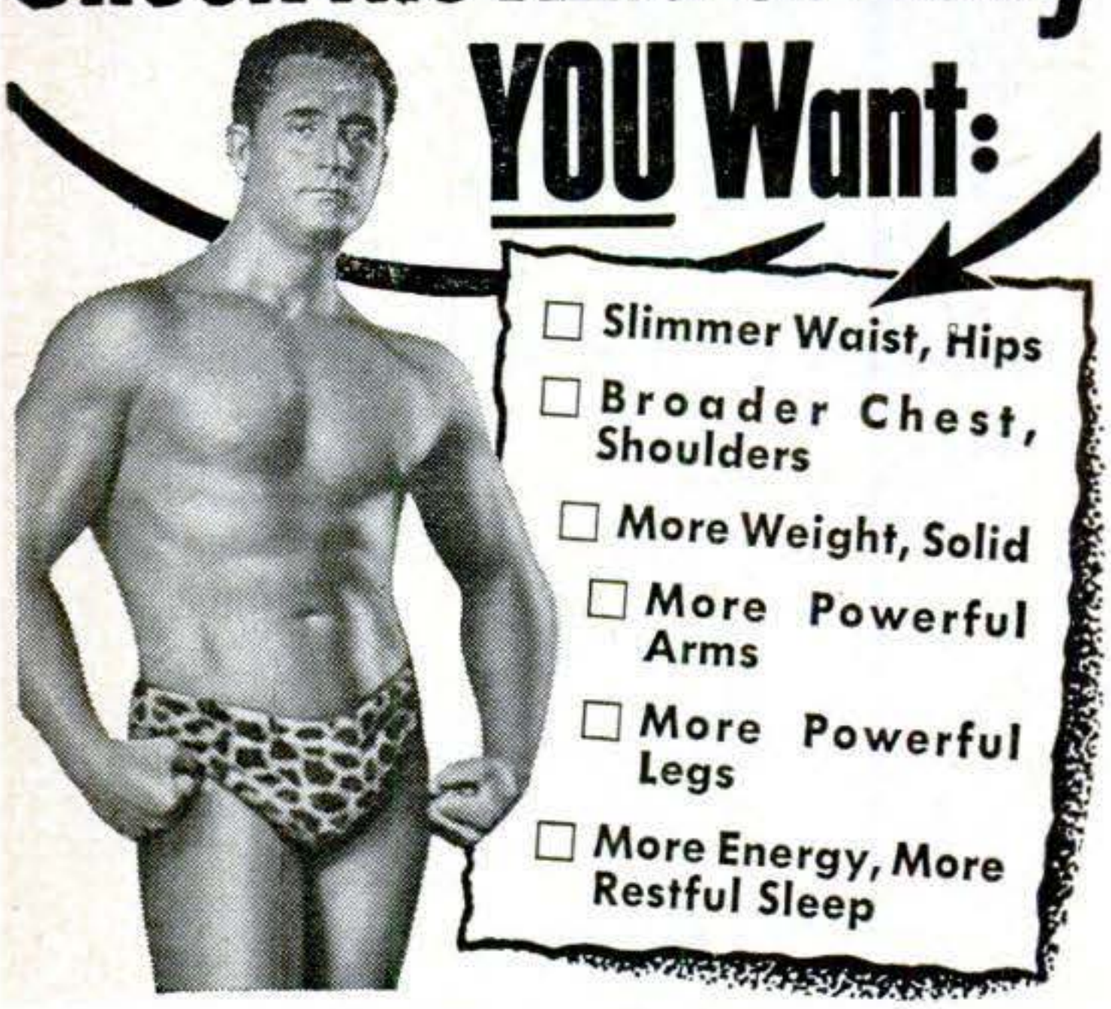

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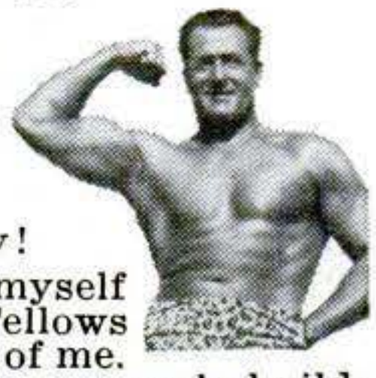

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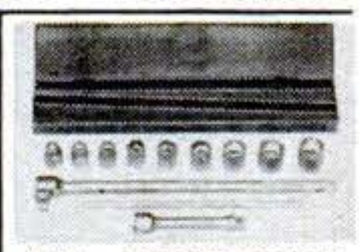

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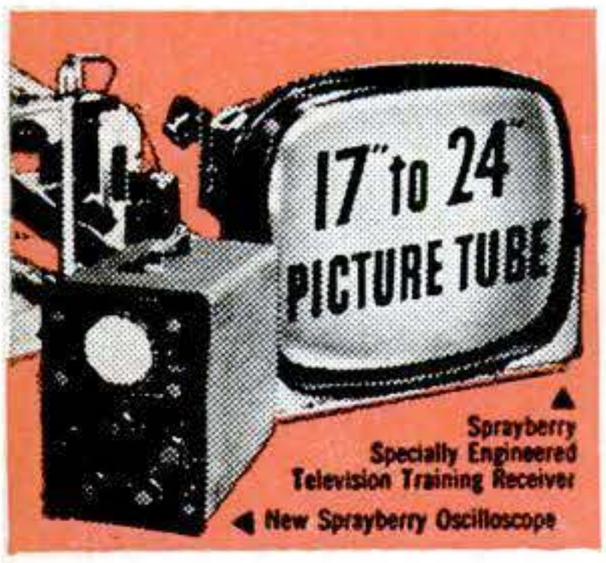

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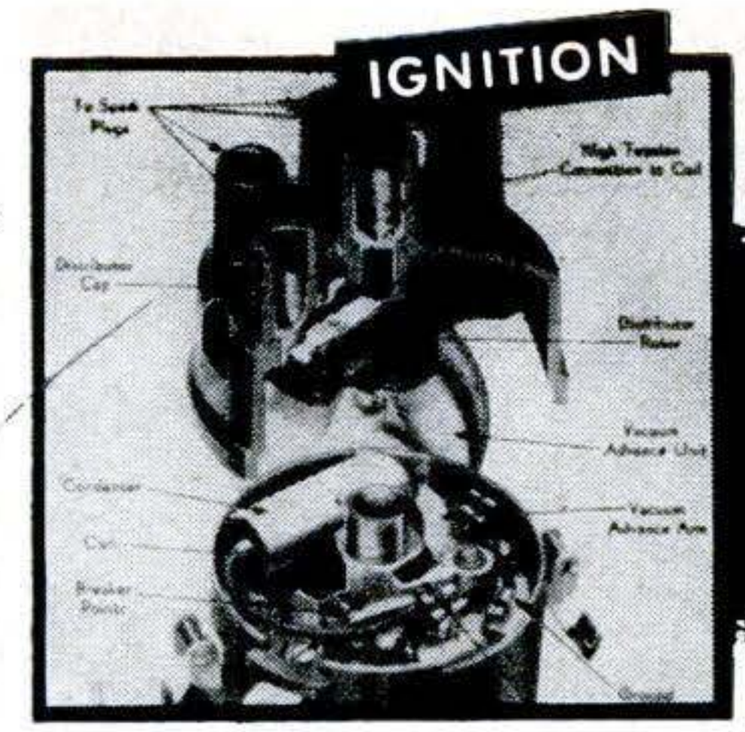

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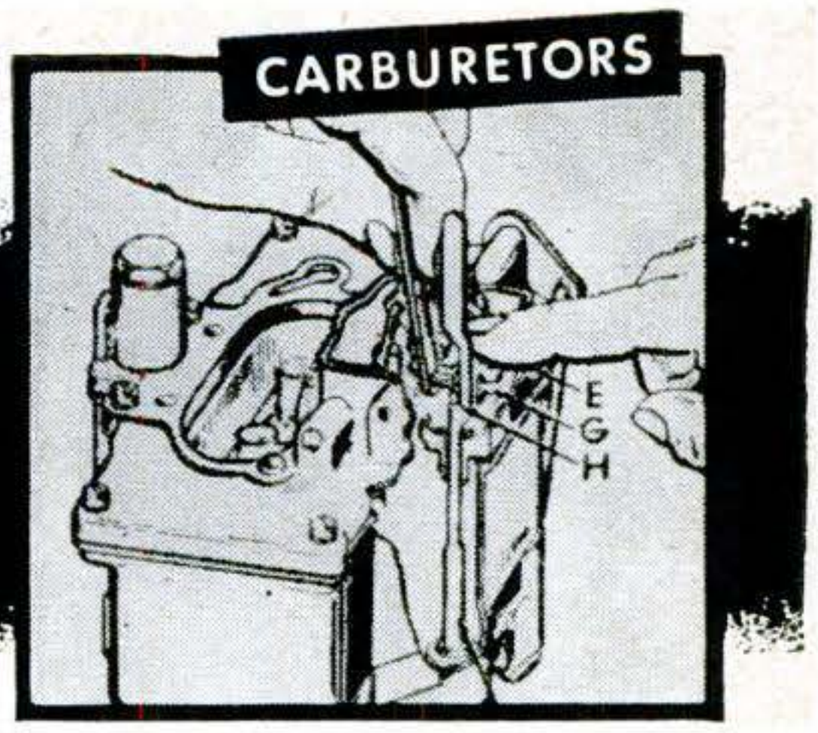

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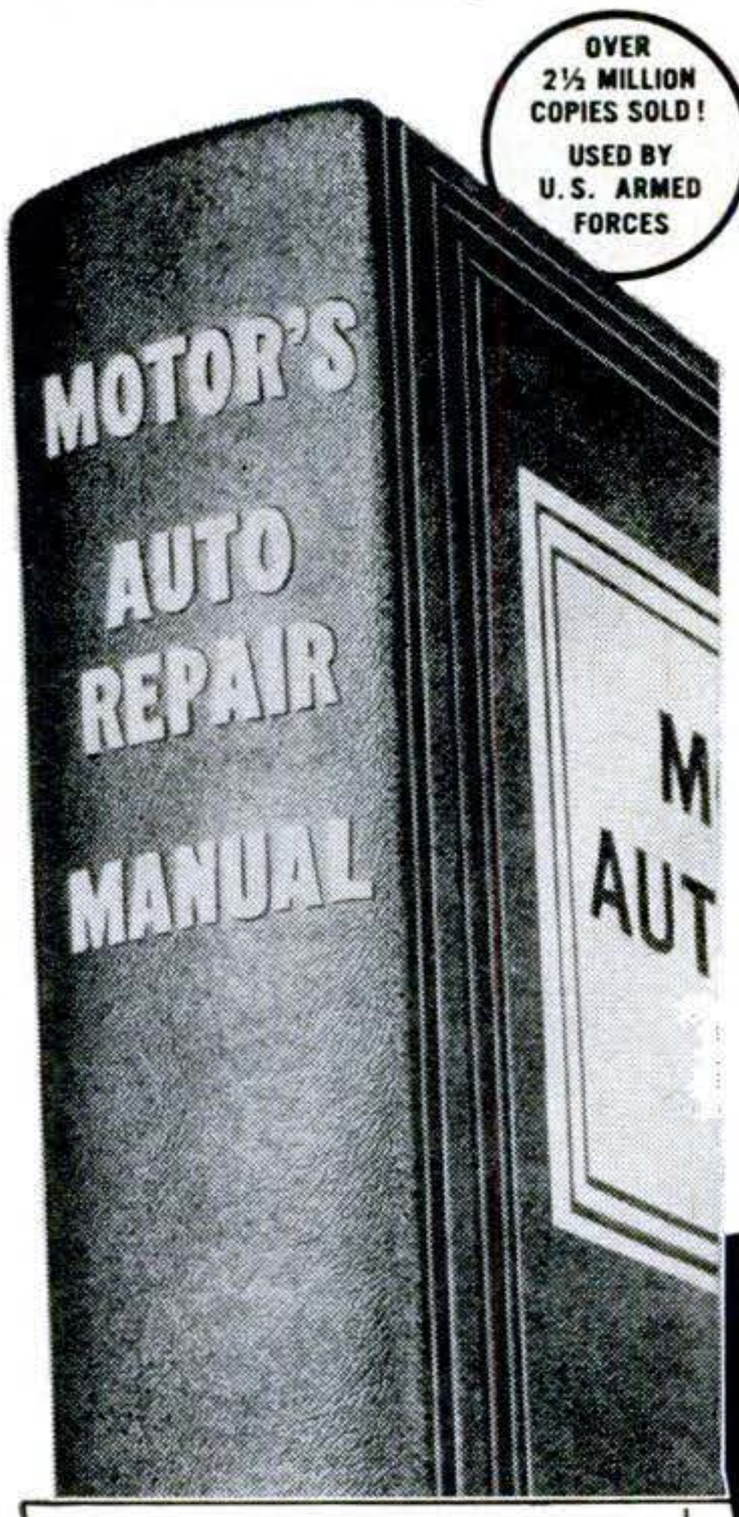

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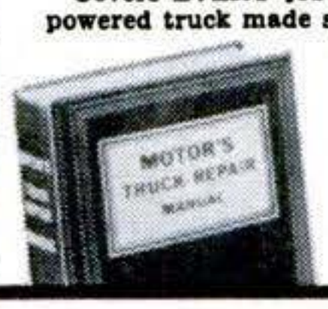

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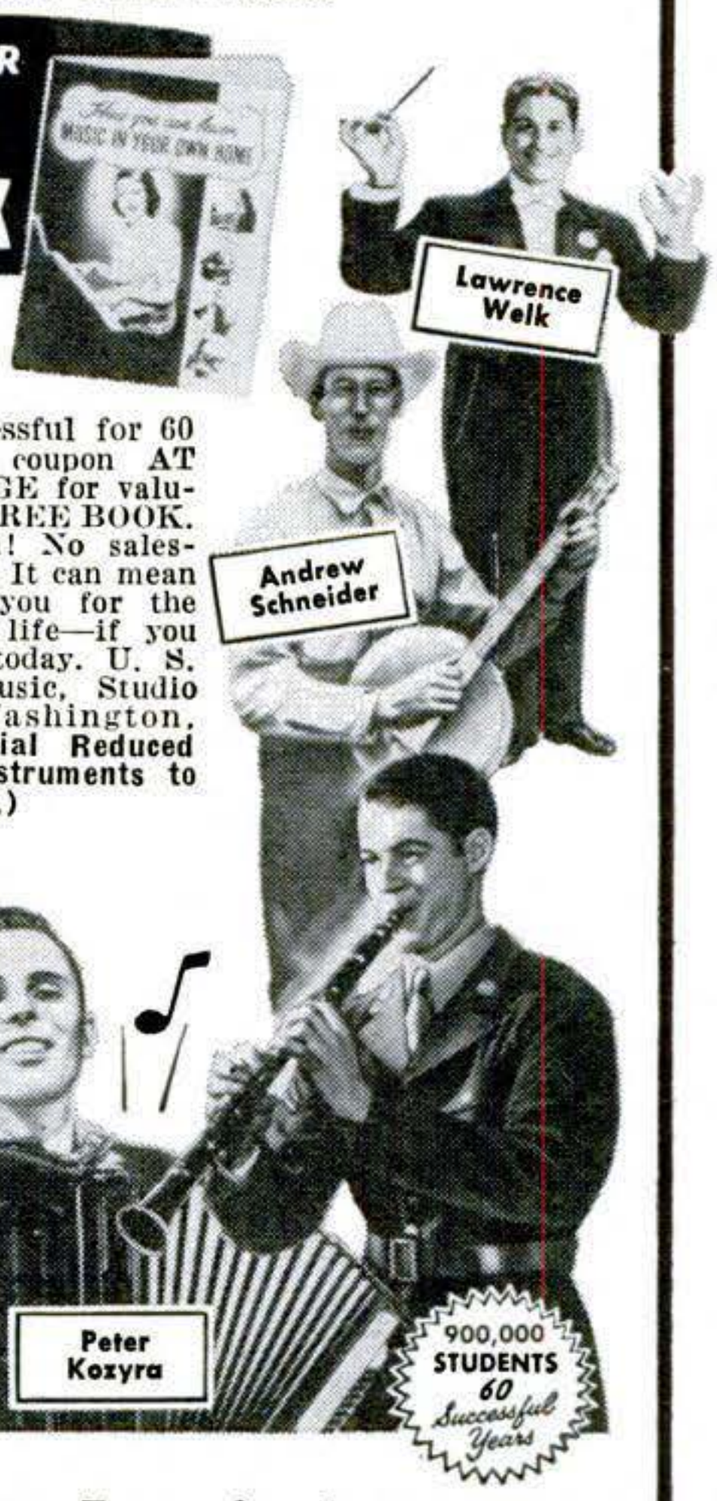

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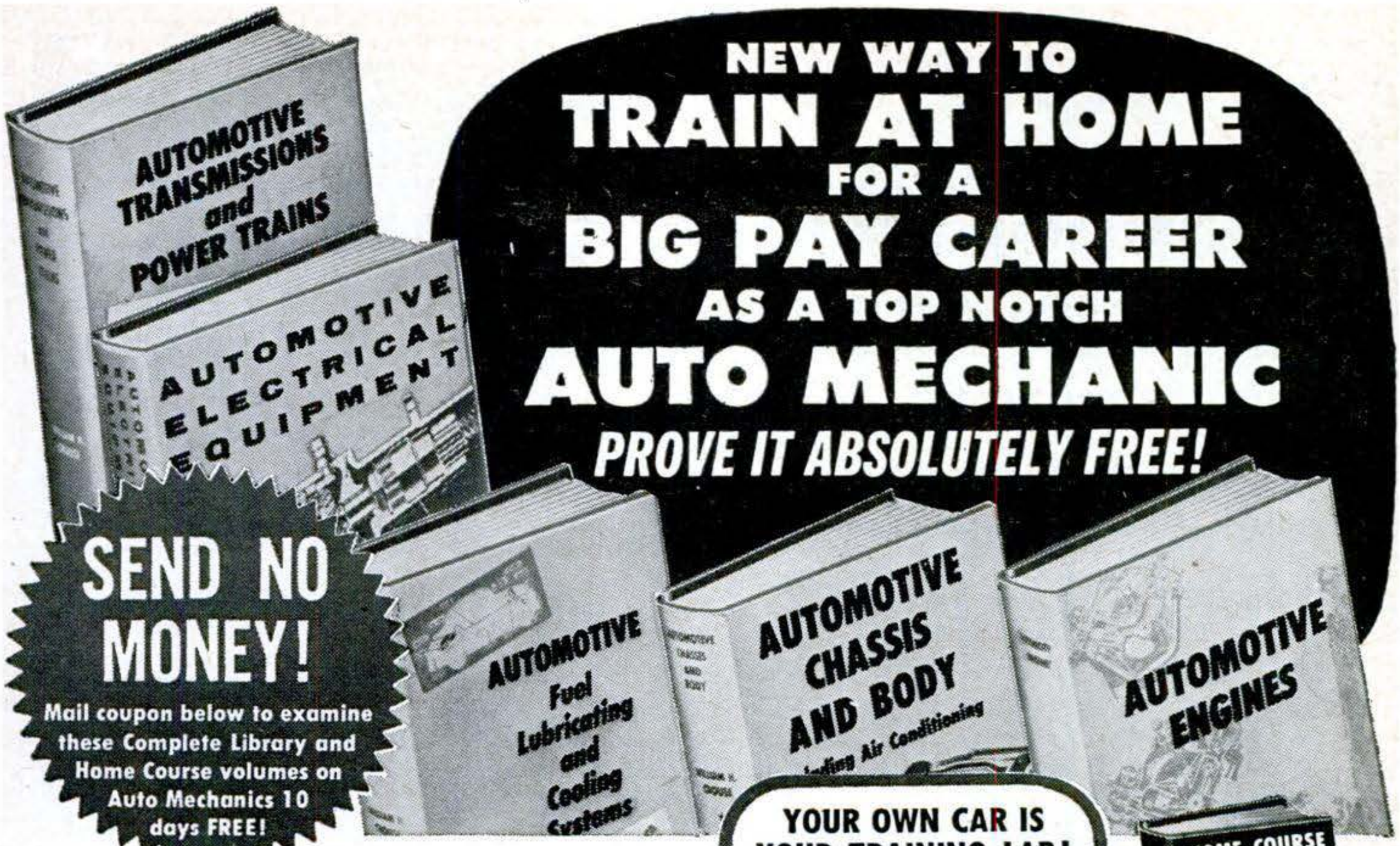

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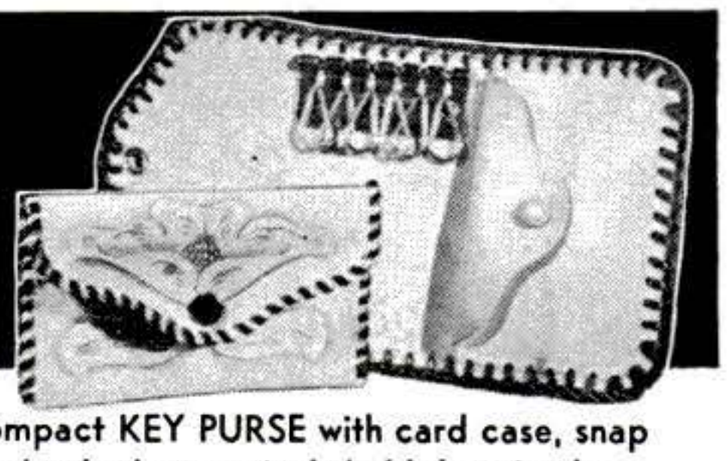

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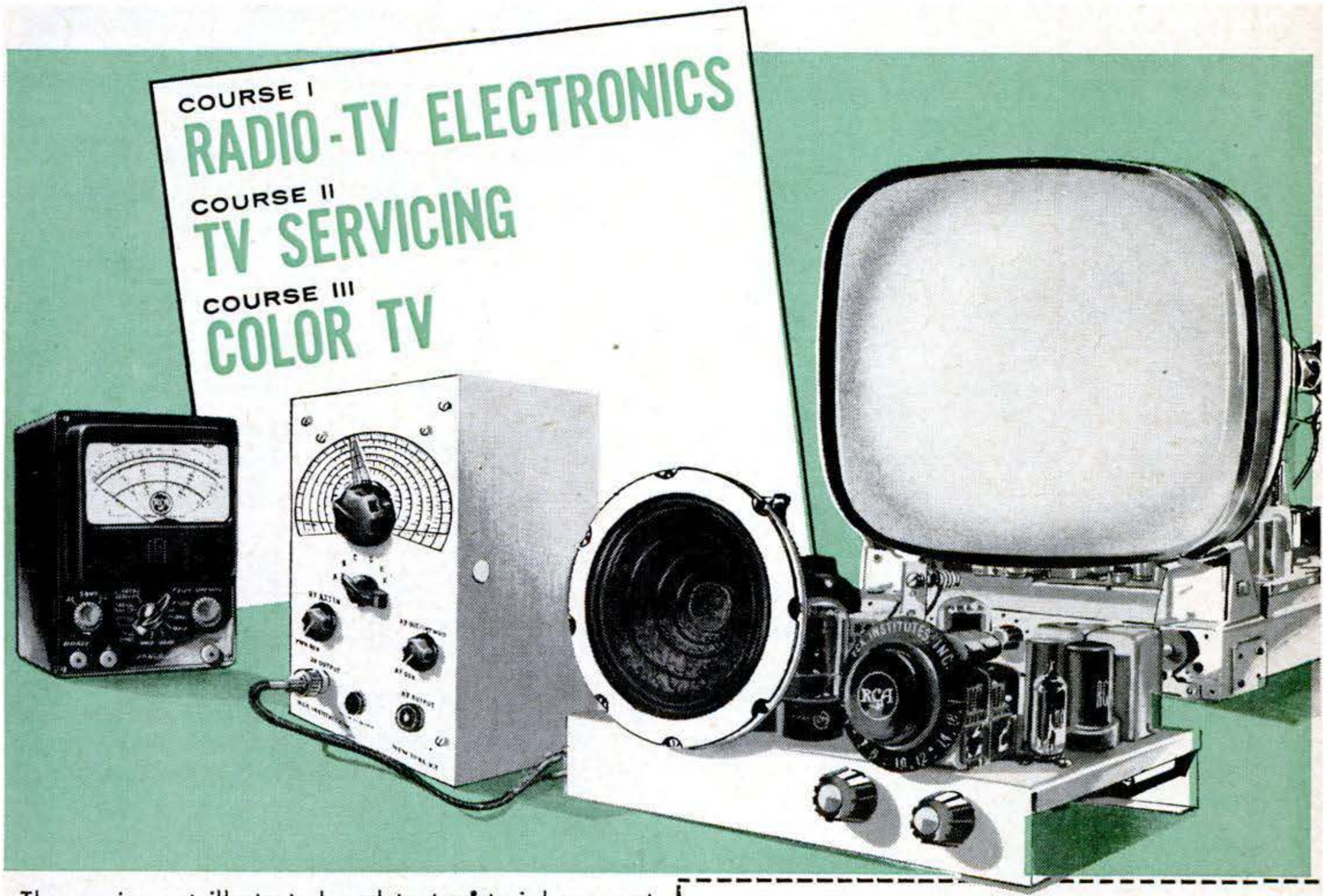

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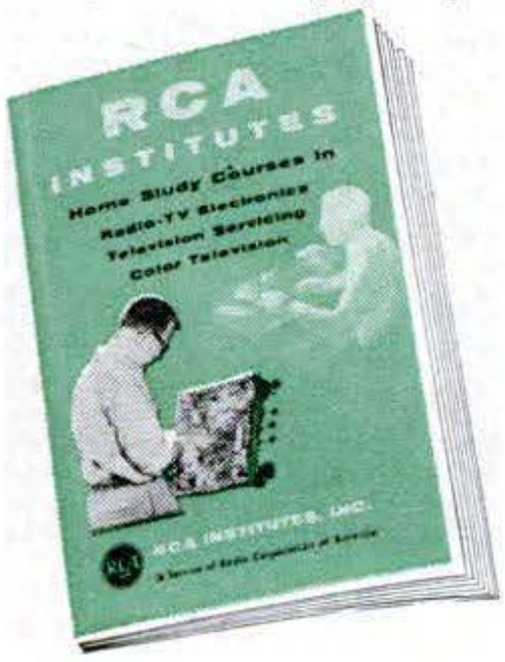

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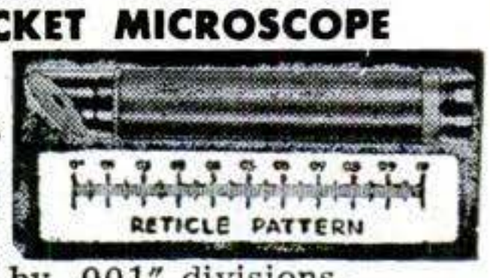

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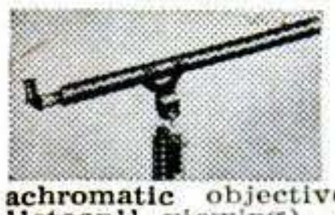

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He had asked me to come to Stockholm to lecture to the Swedes about Lister and other British scientists. On the evening of my arrival, after the champagne, our conversation turned naturally to the problems of public speaking and to the great labour imposed on us lecturers by the need to be word perfect in our lectures.

Borg then told me that his power of memory would probably amaze me—and I had known him, while we were studying law together in Paris to have the most deplorable memory!

So he went to the end of the dining room and asked me to write down a hundred three-figure numbers, calling each one out in a clear voice. When I had filled the edge of an old newspaper with figures, *Borg repeated them to me in the order in which I had written them down and then in reverse order, that is beginning with the last number. He also allowed me to ask him the relative position of different numbers: for example, which was the 24th, the 72nd, and the 38th, and I noticed that he replied to all my questions at once and without effort, as if the figures which I had written on the paper had been also written in his brain.*

I was dumbfounded by such a feat and sought in vain for the trick which enabled him to achieve it. My friend then said: "The thing you have just seen and which seems so remarkable is, in fact, quite simple; everybody has a memory good enough to do the same, but few indeed can use this wonderful faculty."

He then revealed to me how I could achieve a similar feat of memory, and I at once mastered the secret—without mistakes and without effort—as you too will master it tomorrow.

But I did not stop at these amusing experiments. I applied the principles I had learned in my daily work. I could now remember, with unbelievable facility, the lectures I heard and those which I gave myself, the names of people I met—even if it was only once—as well as their addresses, and a thousand other details which were most useful to me. *Finally, I discovered after a while that not only had my memory improved, but that I had also acquired greater powers of concentration; a surer judgment—which is by no means surprising since the keenness of our intellect is primarily dependent on the number and variety of the things we remember.*

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- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
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- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Will measure current consumption *while the appliance under test is in operation.*
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As an Automotive Tester the Model 70 will test:

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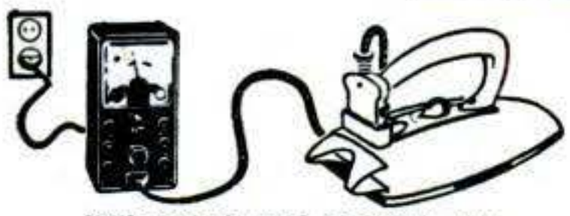
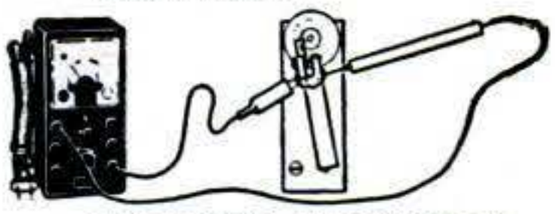
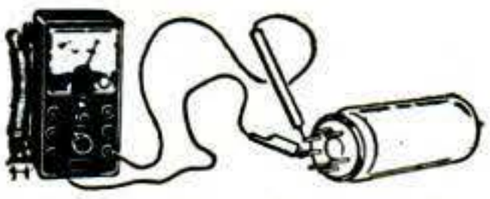


With tester's cord in outlet, current consumption of appliance is read direct on meter when line cord is connected to receptacle on panel. This typical iron takes 7 amperes (Good).

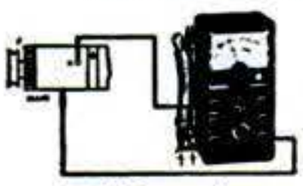
Small electric fan motor indicates 50 ohms (normal resistance).



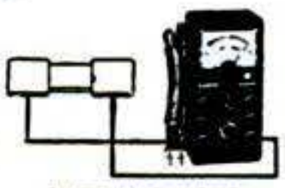
Control circuits of most furnaces use 24 volts obtained from step-down transformer. Here's how to check room thermostat to see if wires to it are live.



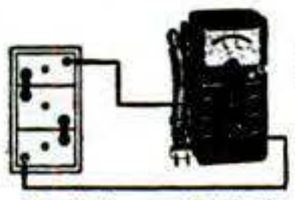
Manual supplied with Model 70 shows meter needle moves to right when test leads are connected to pins 3 and 4 of this 6AU6 tube. Procedure for testing all tubes used in TV are detailed in manual.



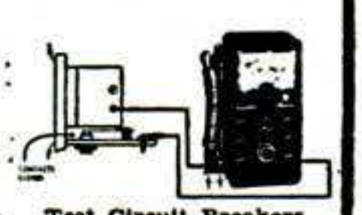
Test Generators



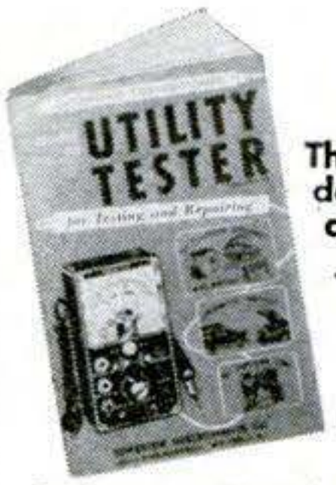
Test Auto Fuses



Test Storage Batteries



Test Circuit Breakers



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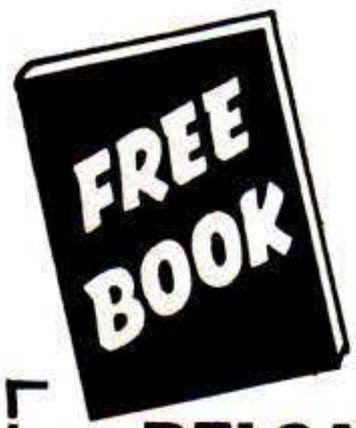

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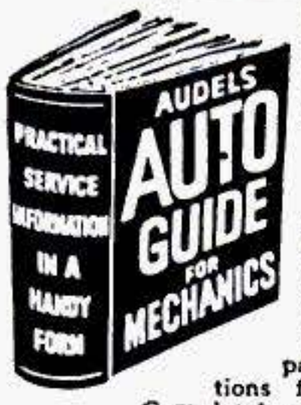

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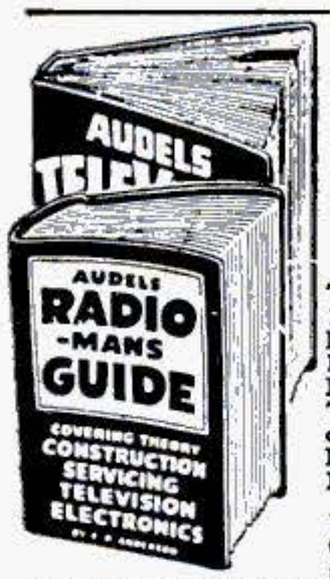

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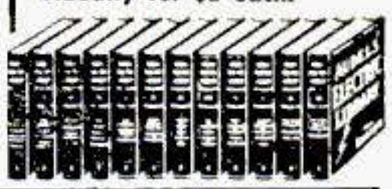

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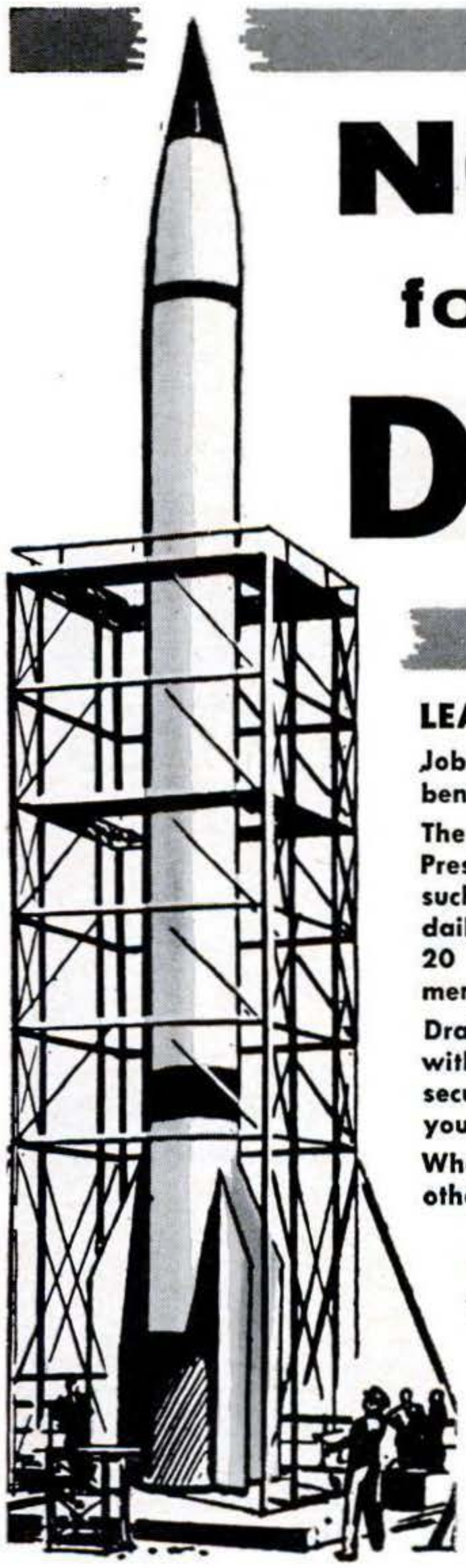

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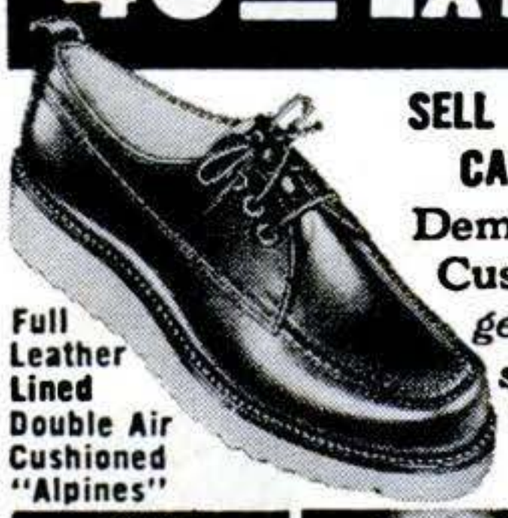

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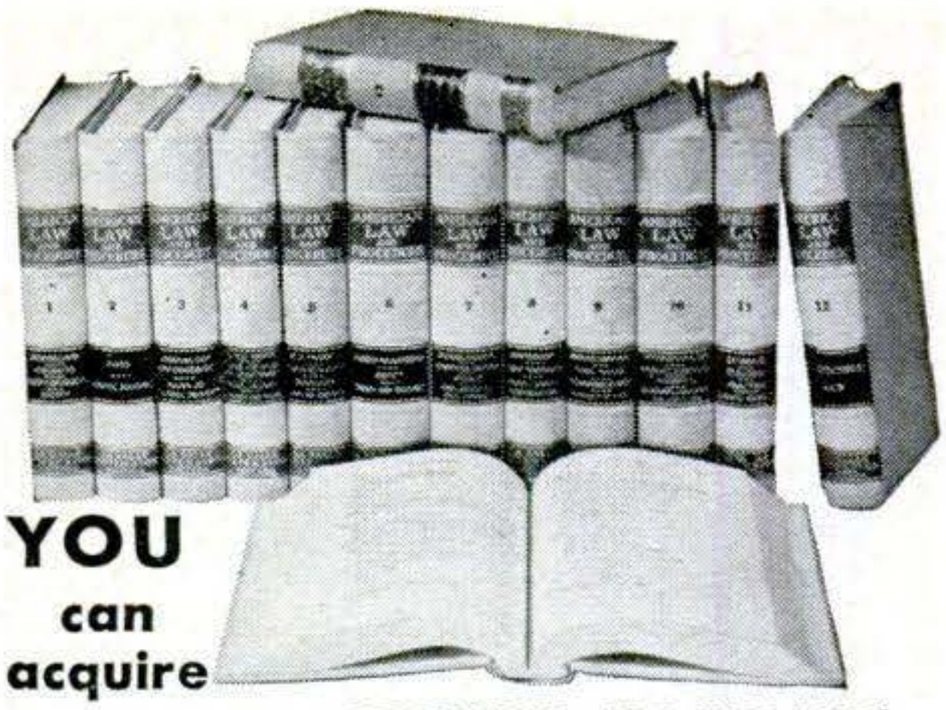

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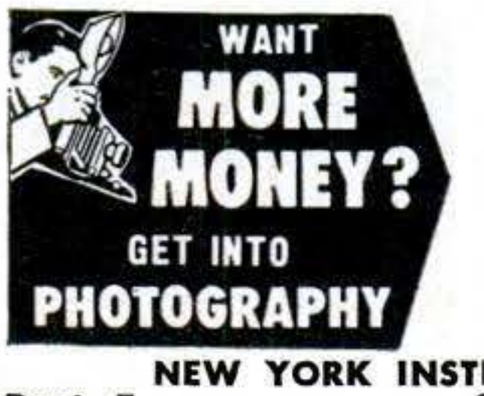

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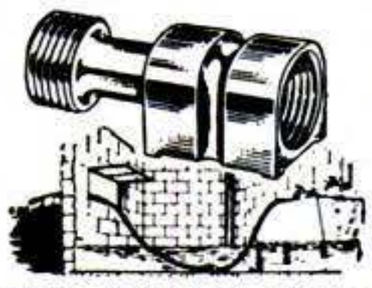

When water gets into your cellar, or you want to drain out a pool, vat, cistern, excavation, boat, don't break your back hand-pumping or bailing. Just connect your garden hose to nearby water faucet and free end to intake side of SPEEDY DRAINER. Connect another length of hose to discharge side, turn on faucet, and SPEEDY DRAINER will pump out water at the rate of 300 gallons per hour, right down to the bottom. This precision-made, all brass, siphon pump has no moving parts to wear, jam or rust. It's priceless when you need it, yet costs only $2.98 postpaid. Plus postal charges if C.O.D. MONEY BACK GUARANTEE.

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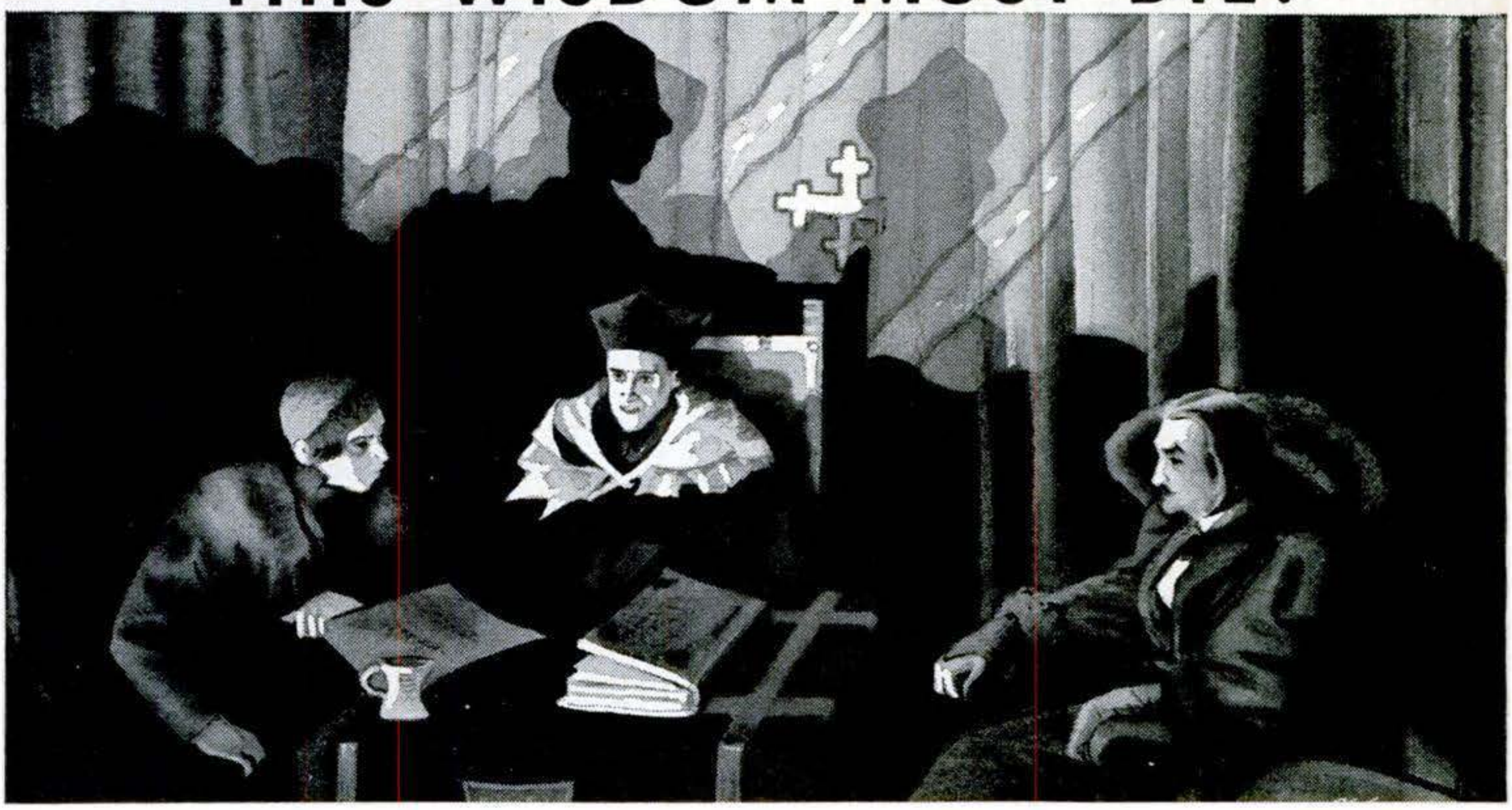
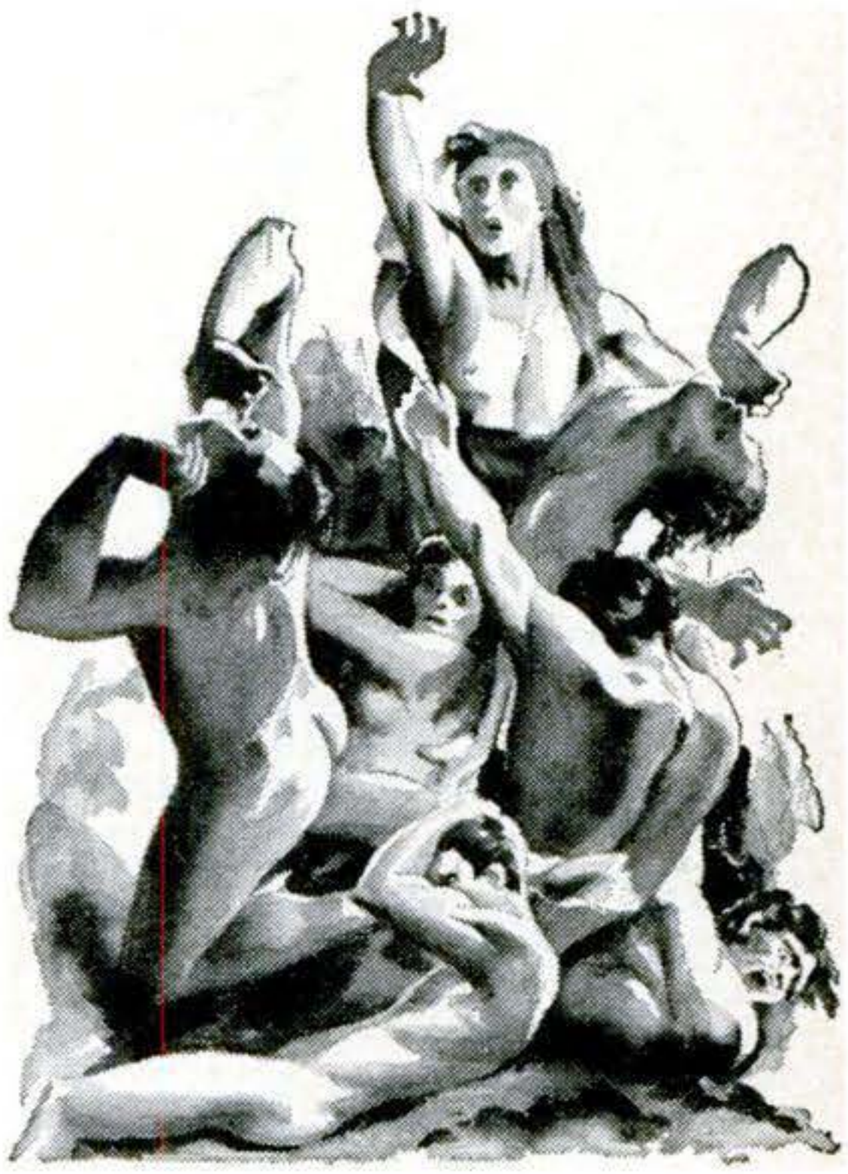


Truths That Have Been Denied Struggling Humanity



FOR every word that has left the lips of bishops or statesmen to enlighten man, a thousand have been withheld. For every book publicly exposed to the inquiring mind, one hundred more have been suppressed — *damned to oblivion.* Each year of progress has been wilfully delayed centuries. Wisdom has had to filter through biased, secret sessions or ecclesiastical council meetings, where high dignitaries of state and church alone proclaimed what man should know.

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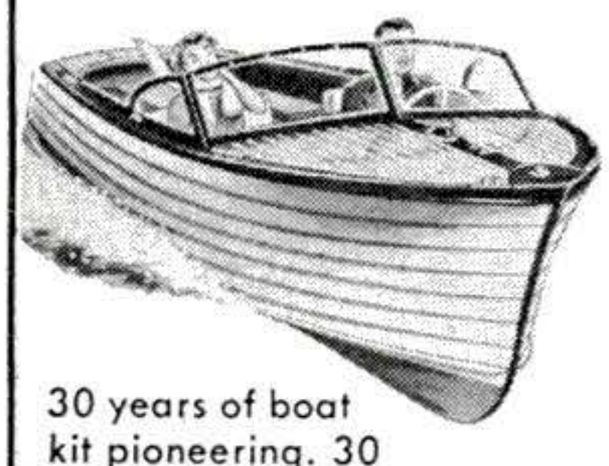

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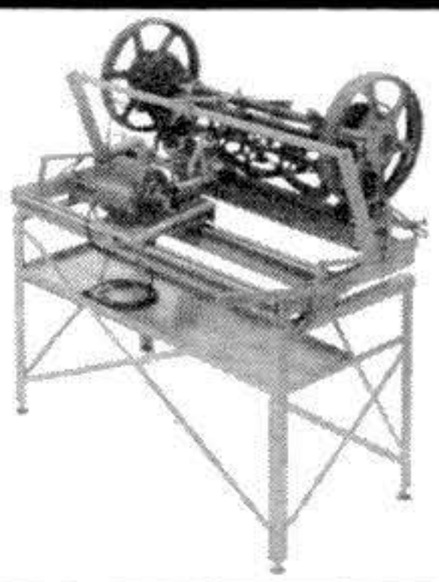

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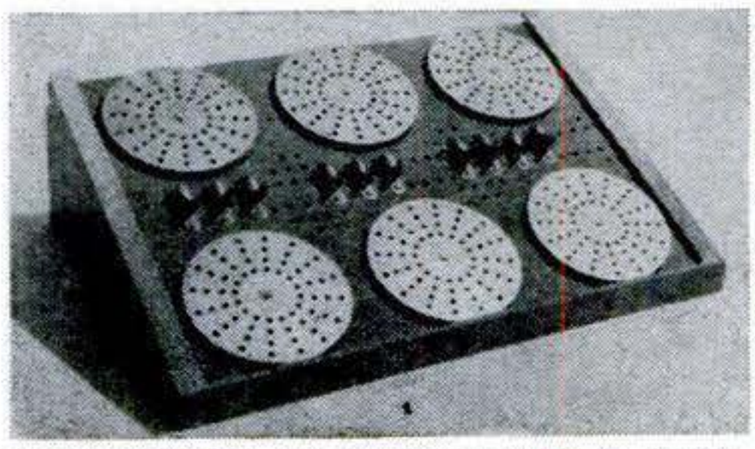

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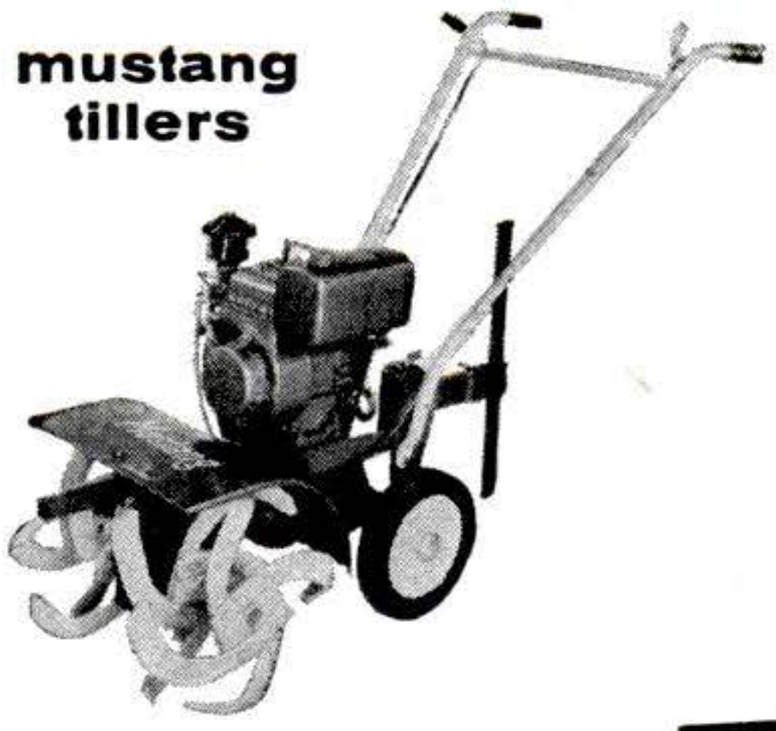

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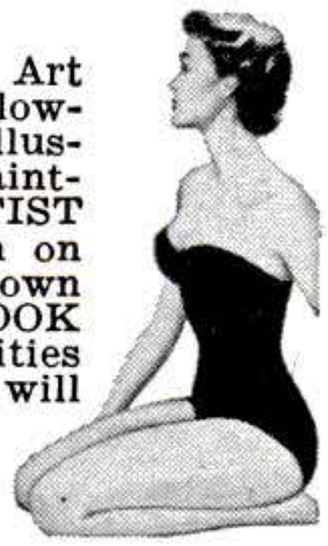

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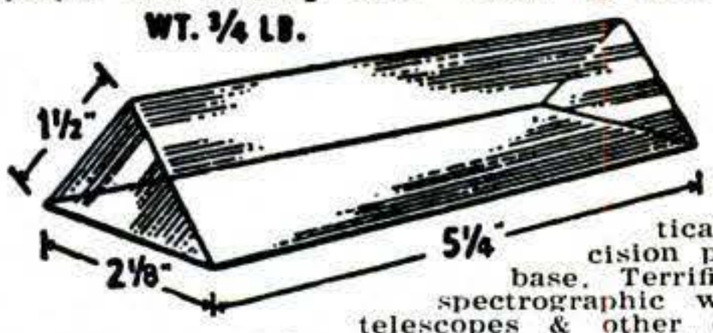

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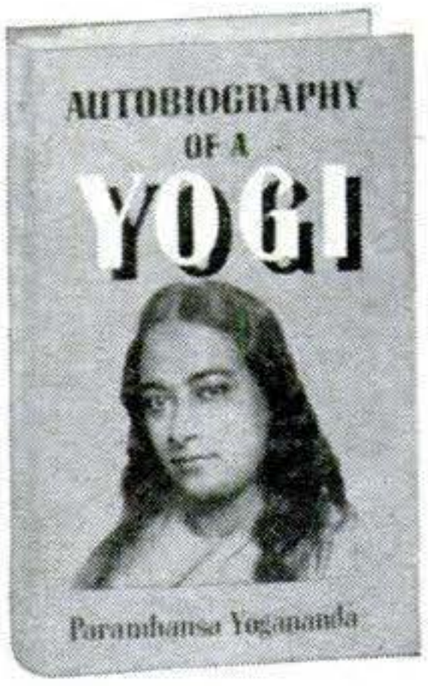

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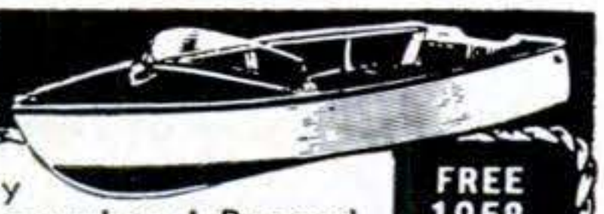

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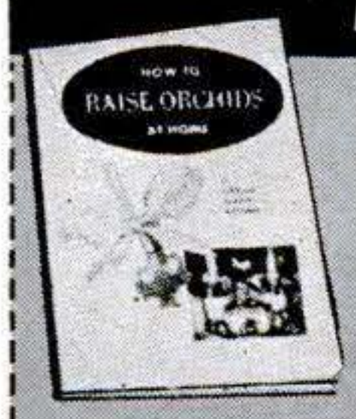

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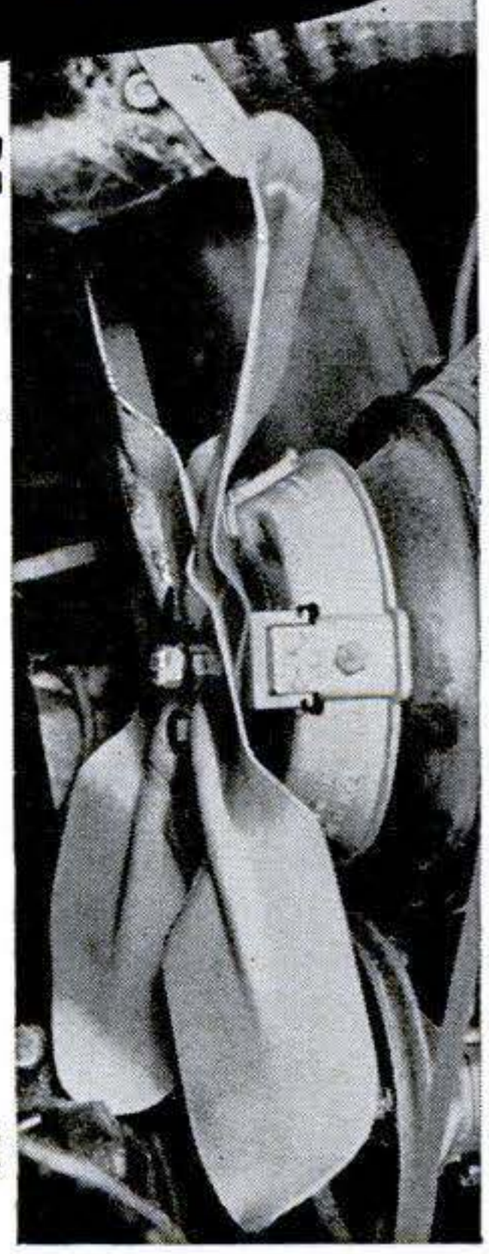

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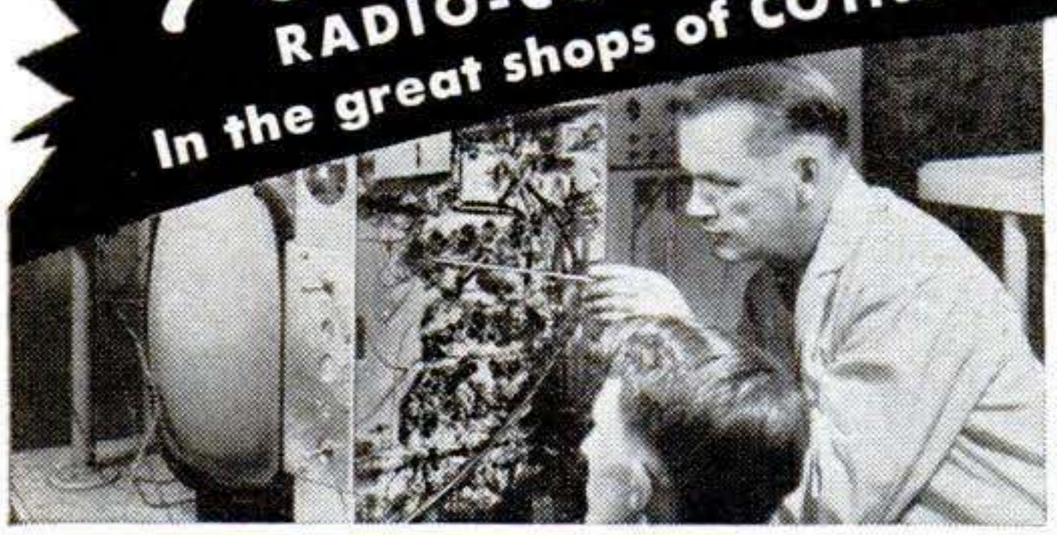

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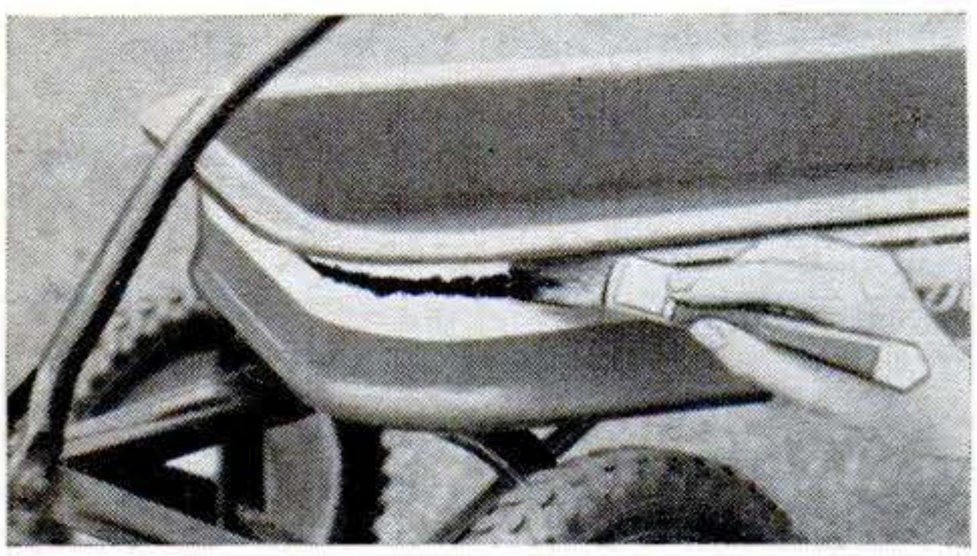

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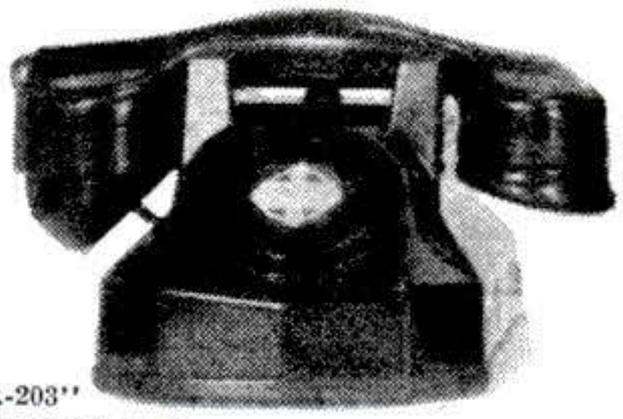

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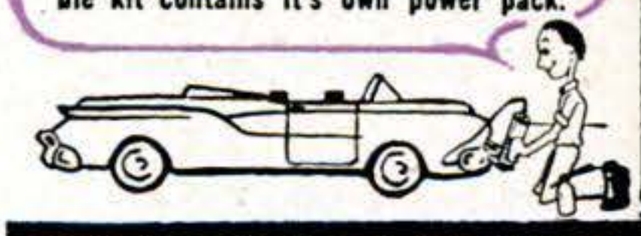

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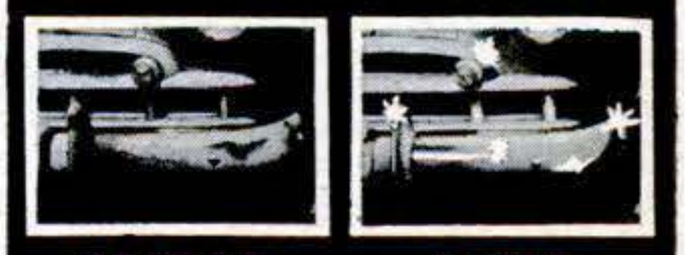

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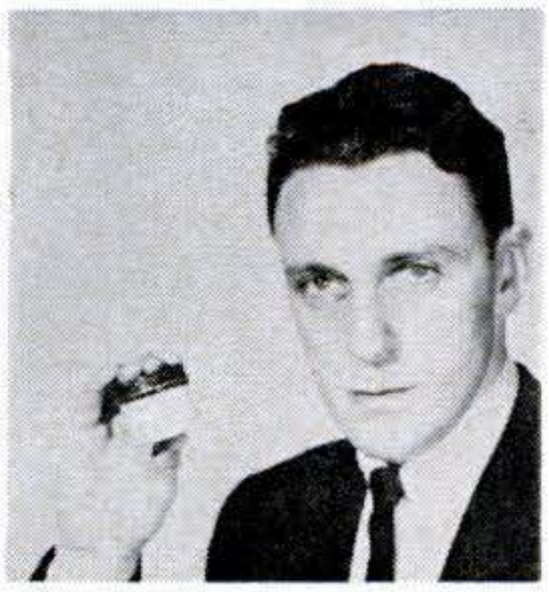

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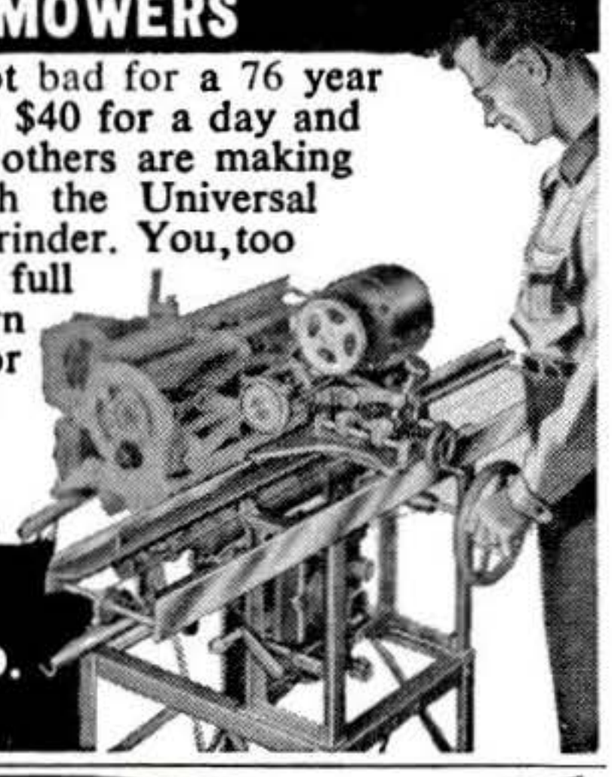

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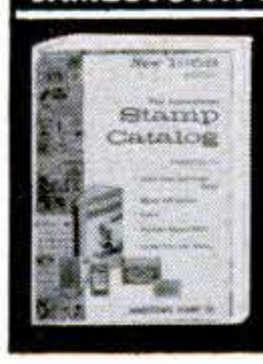

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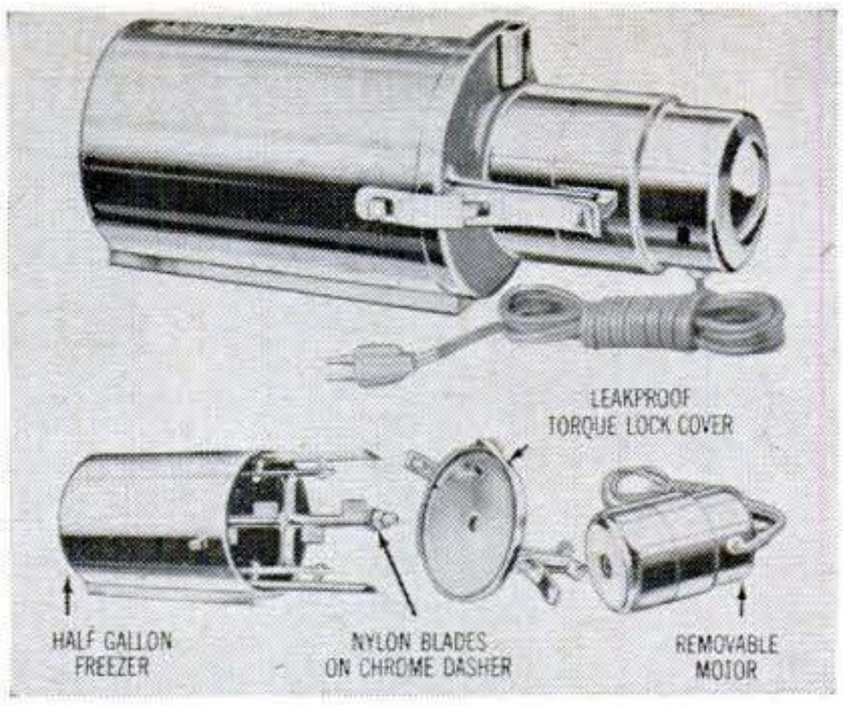

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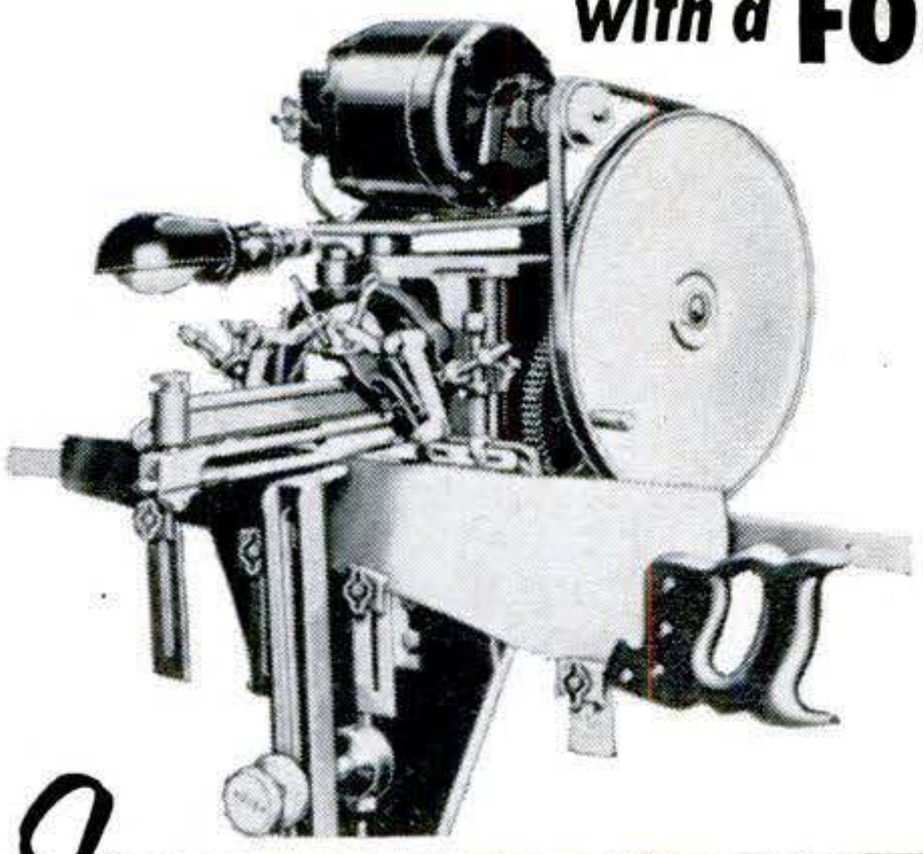

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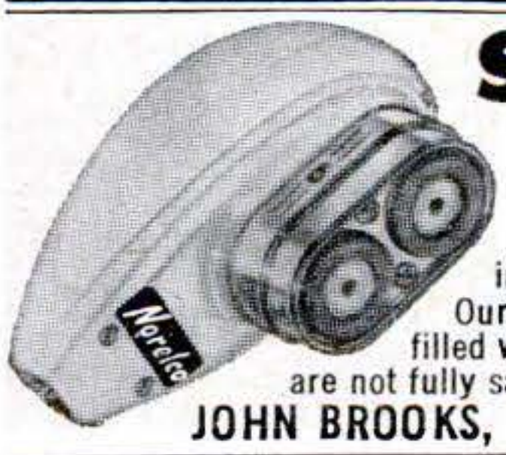

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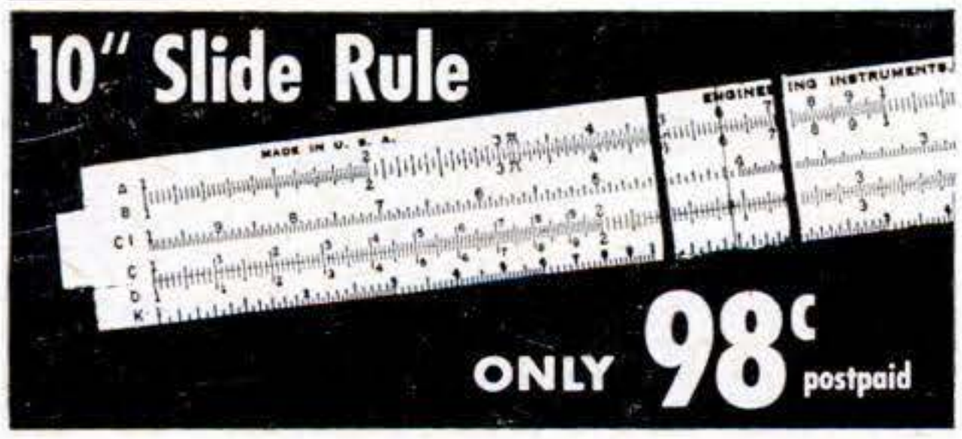

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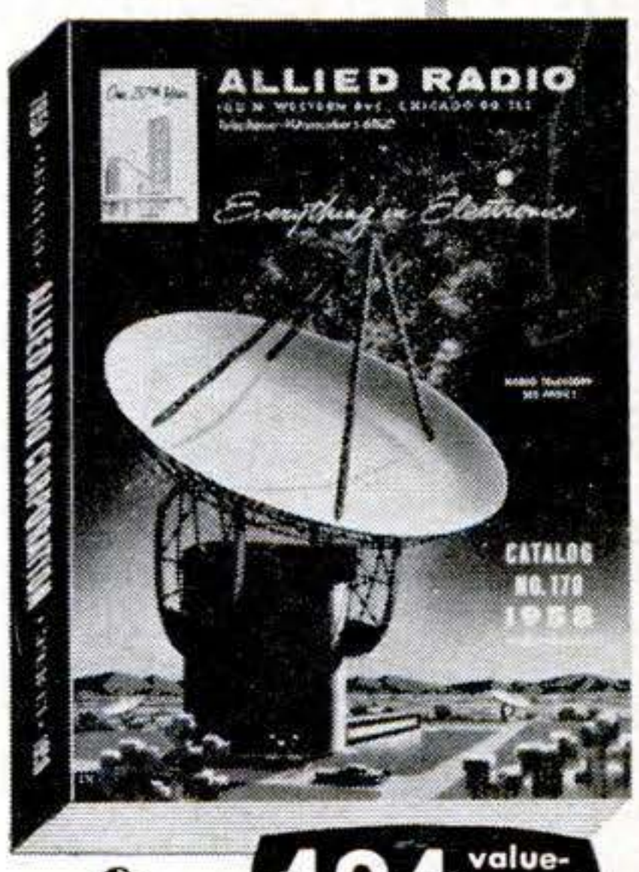

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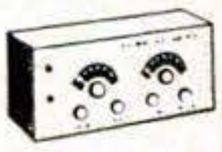

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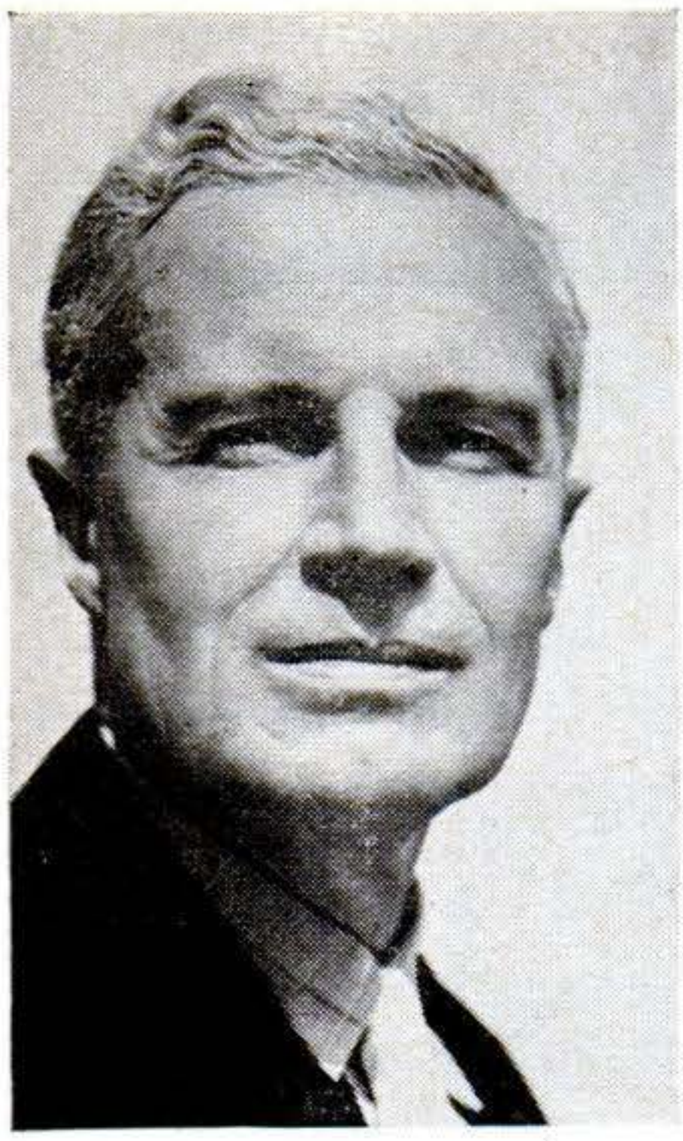

I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life, is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows". It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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NEW Songwriters, Songpoets share $33 million dollars yearly. Any subject songs, poems revised, composed, published, promoted by largest firm. Information, appraisal Free from Nordyke Music Publishers, 6000 Sunset, Hollywood 28PS, California.

ELECTRIC Guitars, amplifiers, wholesale. Free catalog. Carvin, PSM, Covina, California.

COMPLETE Music Service for Amateur Songwriters. Jerry Colonna, Box 888S, Burbank, Calif.

VIOLINMAKERS supplies. Free Catalog. 309 W. Fourth, Los Angeles 13, Calif.

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36 RADIO, TELEVISION, SUPPLIES & EQUIPMENT

BUILD 12 receivers, transmitter, signal tracer, code oscillator, signal injector. Complete home radio course only $22.95. No need to spend hundreds of dollars for a course. For a mere fraction of its real value, our course trains you in basic radio, TV, Hi-Fi. Course includes everything you need: tubes, parts, tools, instructions. Write for full information. Also receive Free Servicing Literature on Radio, TV, Hi-Fi worth $1.50. Progressive "Edu-Kits" Inc., Dept. 551A, 497 Union Avenue, Brooklyn 11, N. Y.

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RECEIVING tubes, wholesale list free. Spada, 4 Eastview, Rocky Hill, Conn.

CRYSTAL—Radio experimenters. Write to Hulet, 305 Hope, Lakewood, New Jersey.

"15 TESTED One-tube Circuits" with catalog—25c. Laboratories, 328-T Fuller, Redwood City, California.

CRYSTAL Radio kit $1.00, preassembled $1.25, phone $1.75; catalogue. Clearco Crystal Company, 2966 North 4th, Milwaukee 12, Wisconsin.

KITS: Shortwave Radio $3.50—Improved Crystal Radio 75c. Alliance, 2059 60th, Brooklyn 4, New York.

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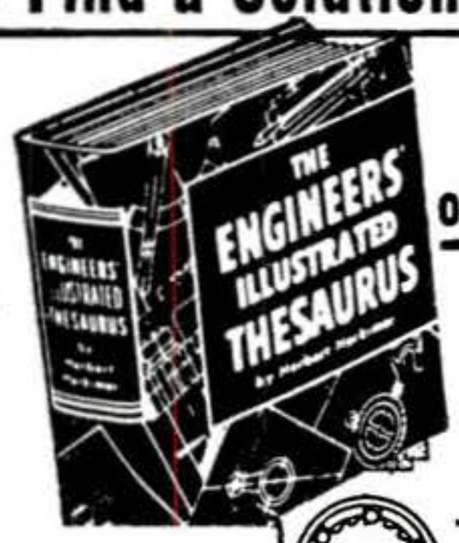

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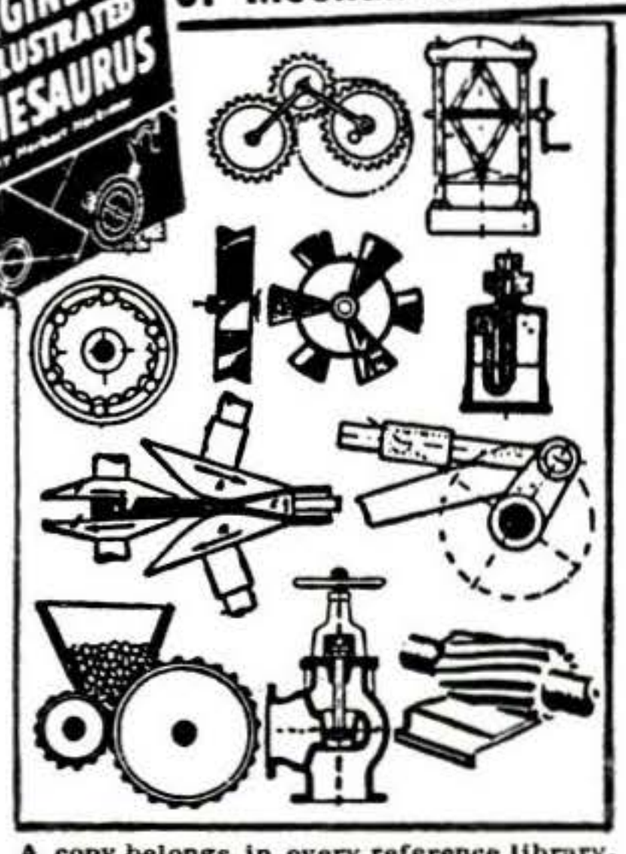

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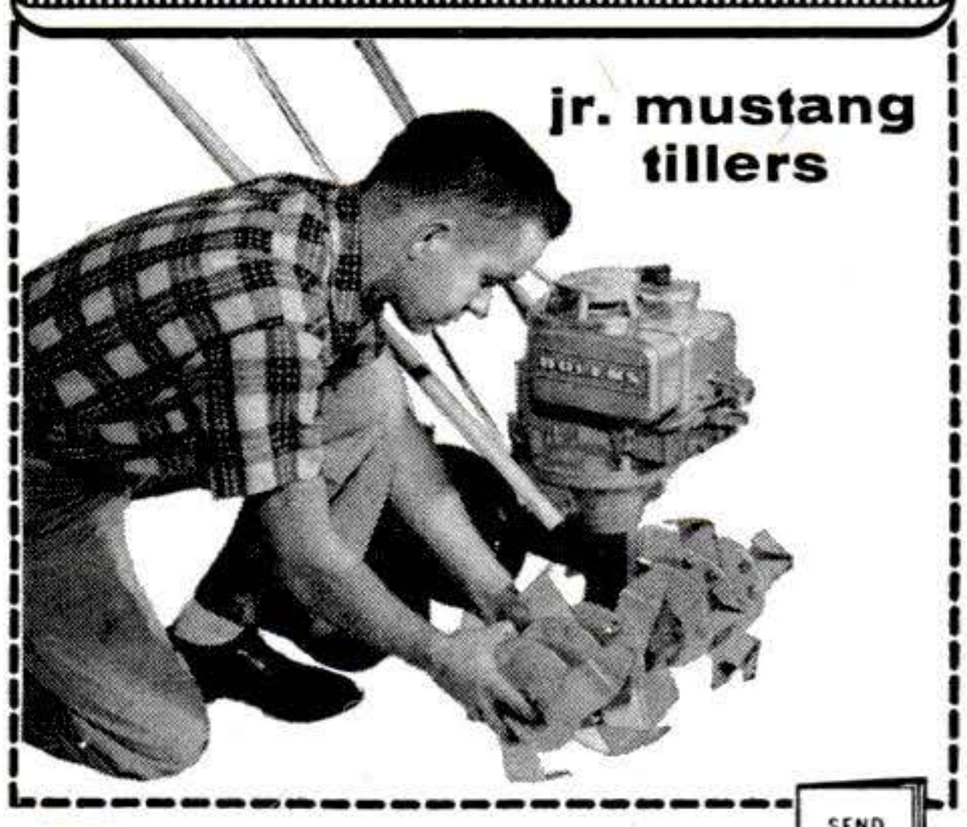

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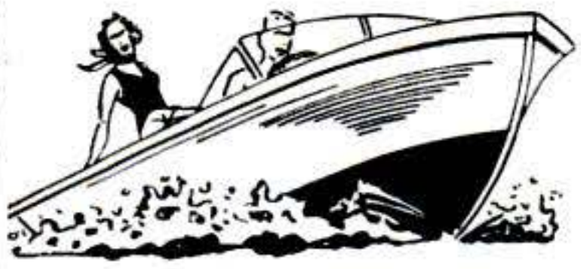

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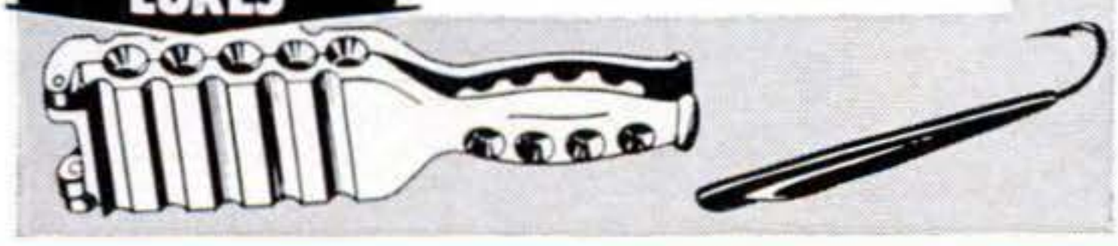

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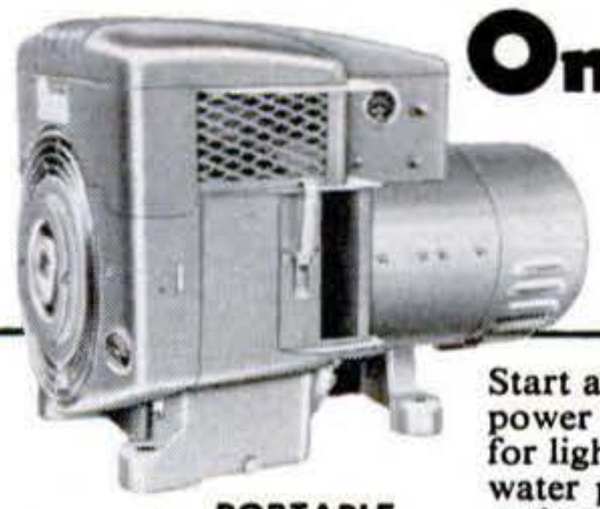

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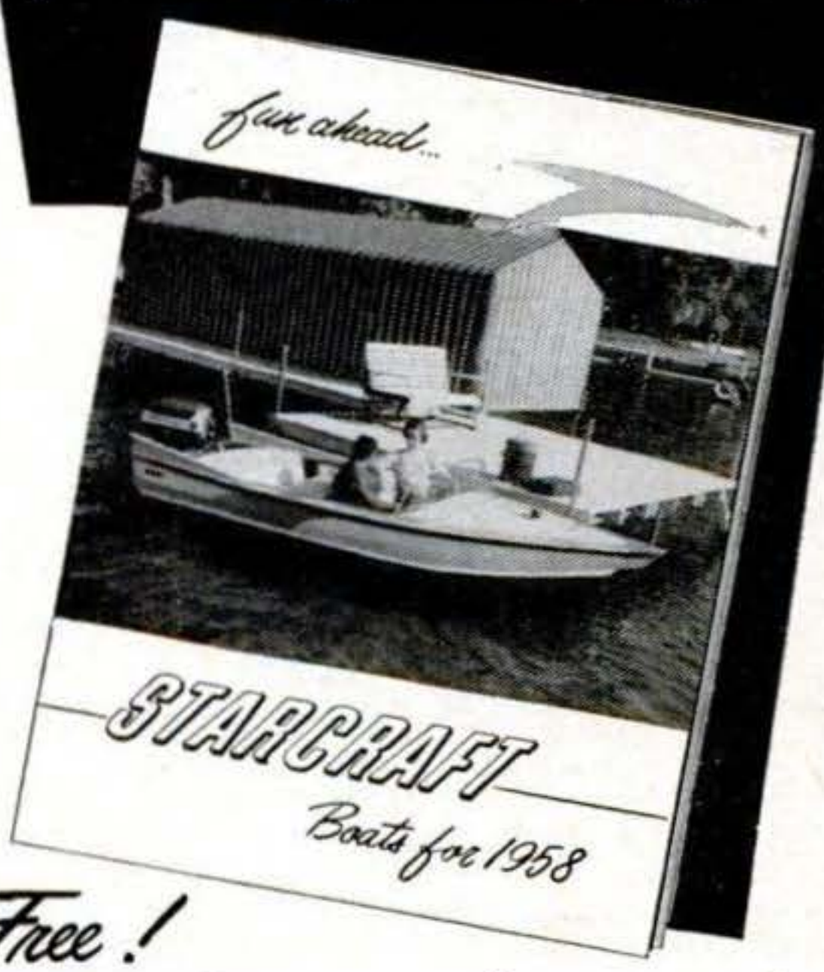

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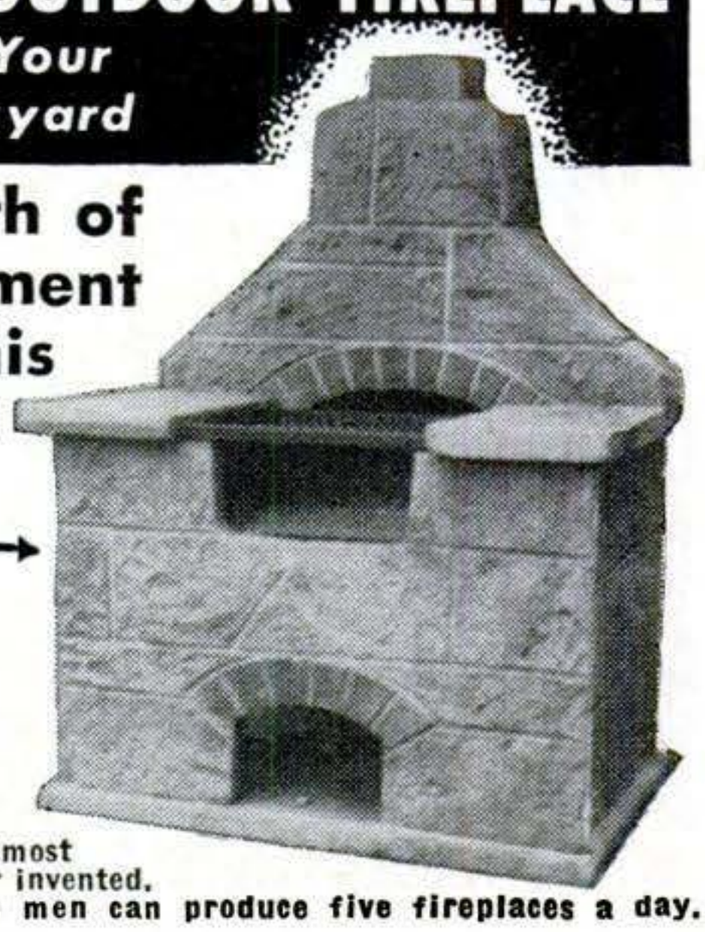

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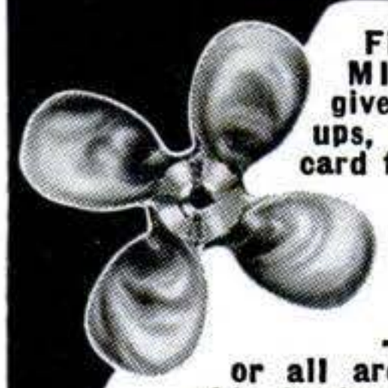

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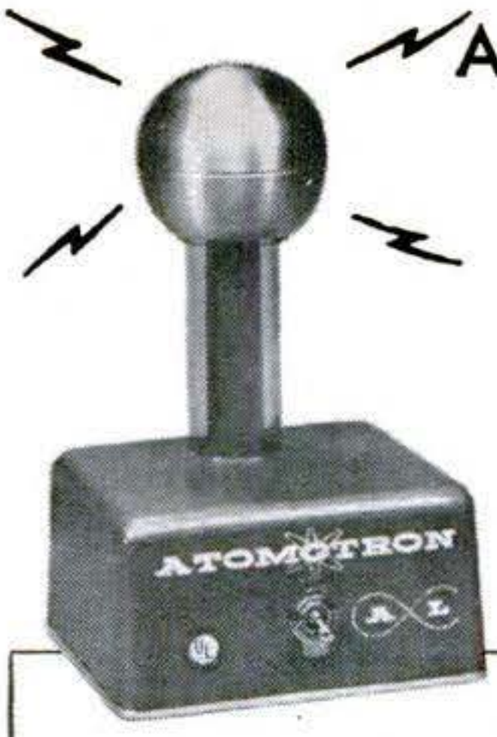

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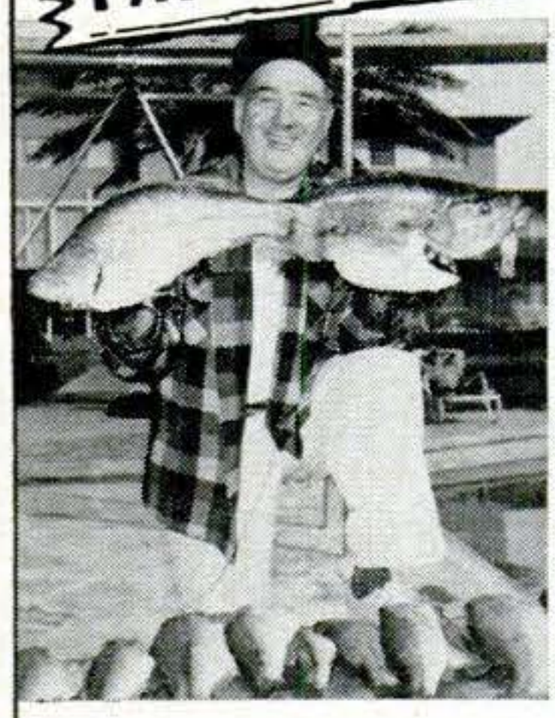

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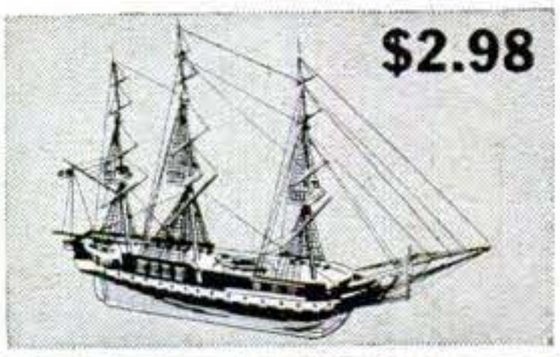

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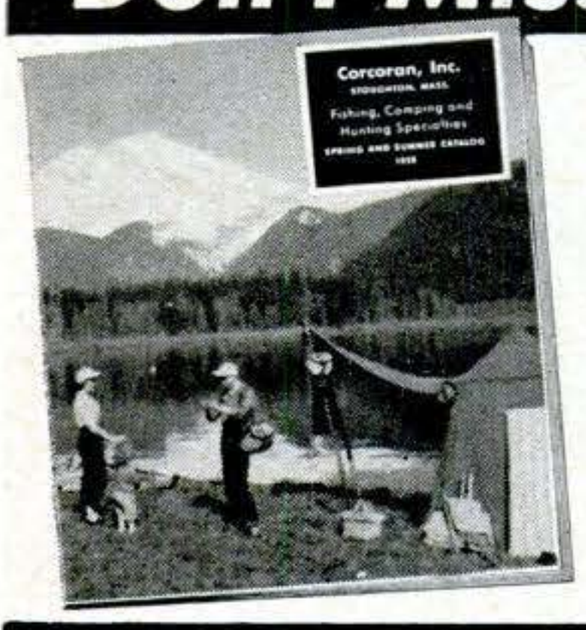

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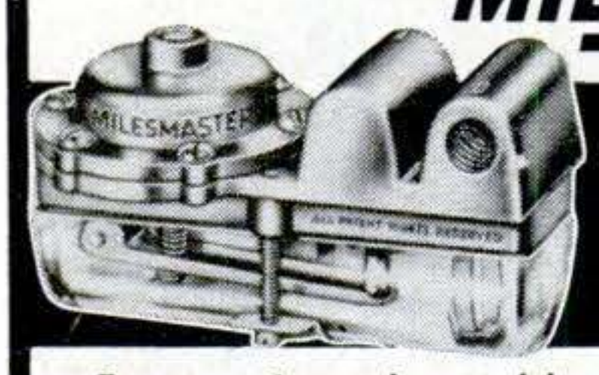

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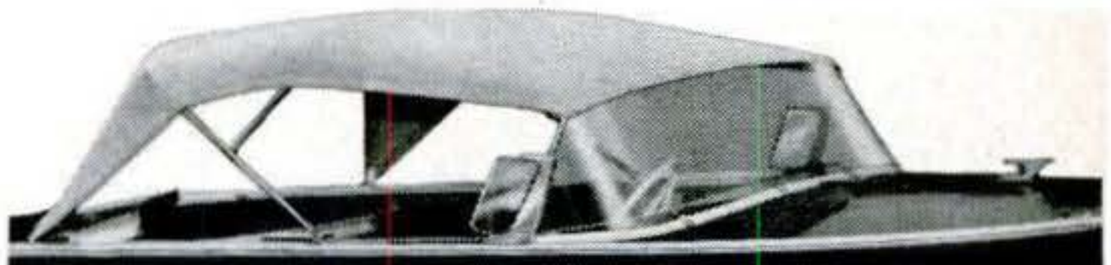

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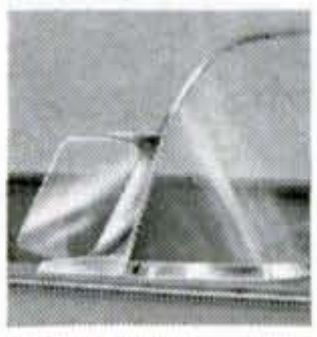

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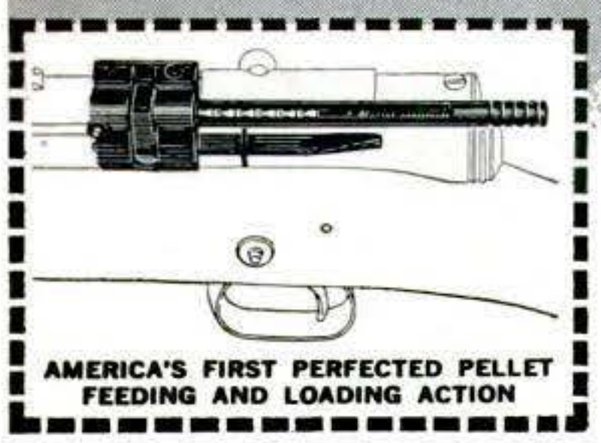

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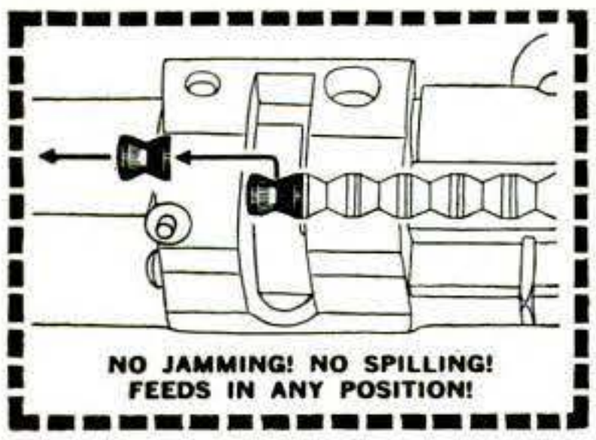

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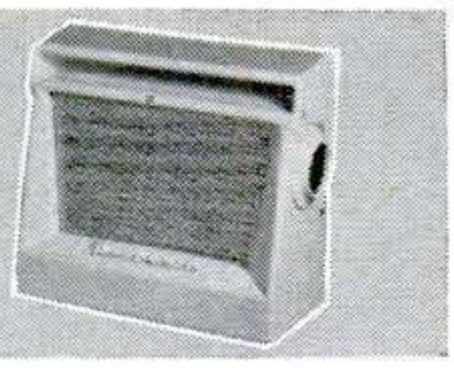

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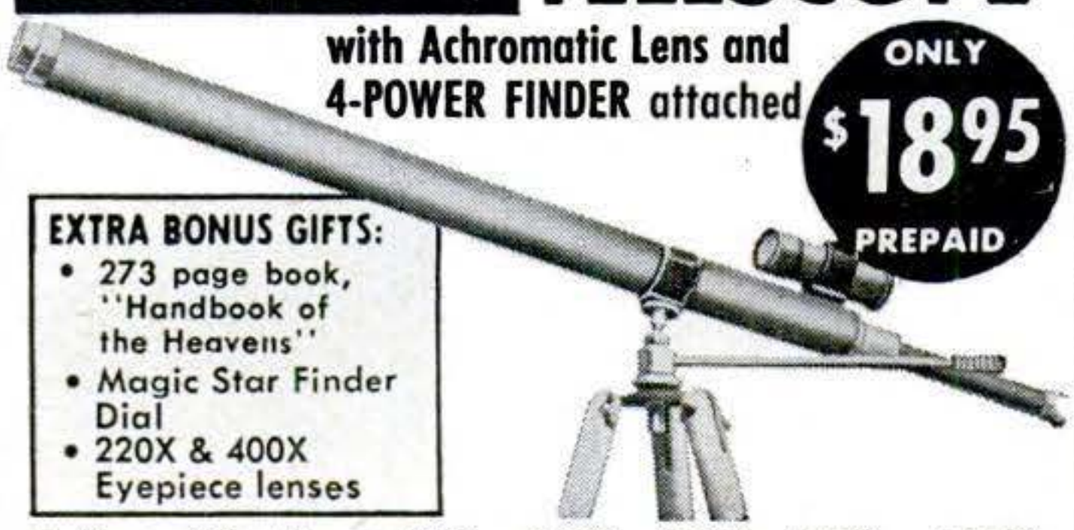

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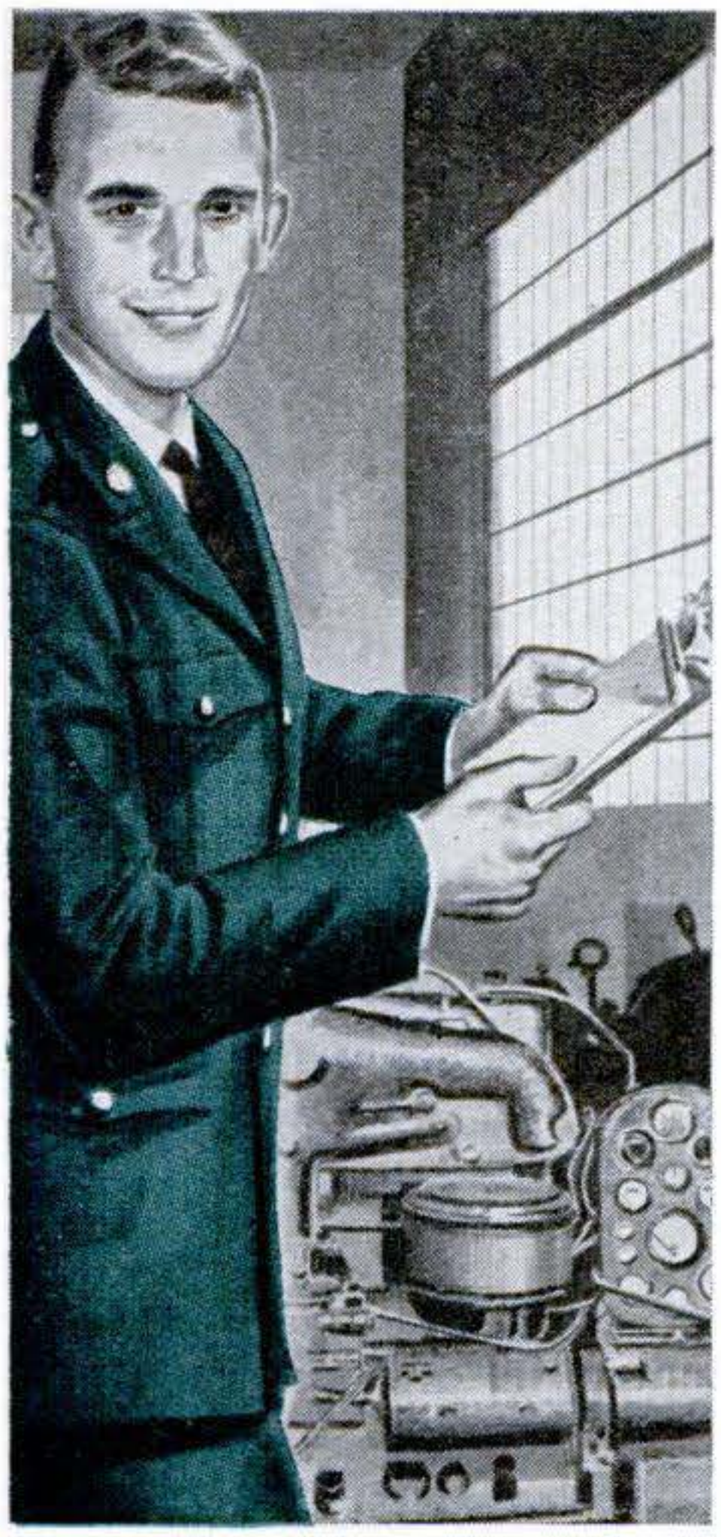

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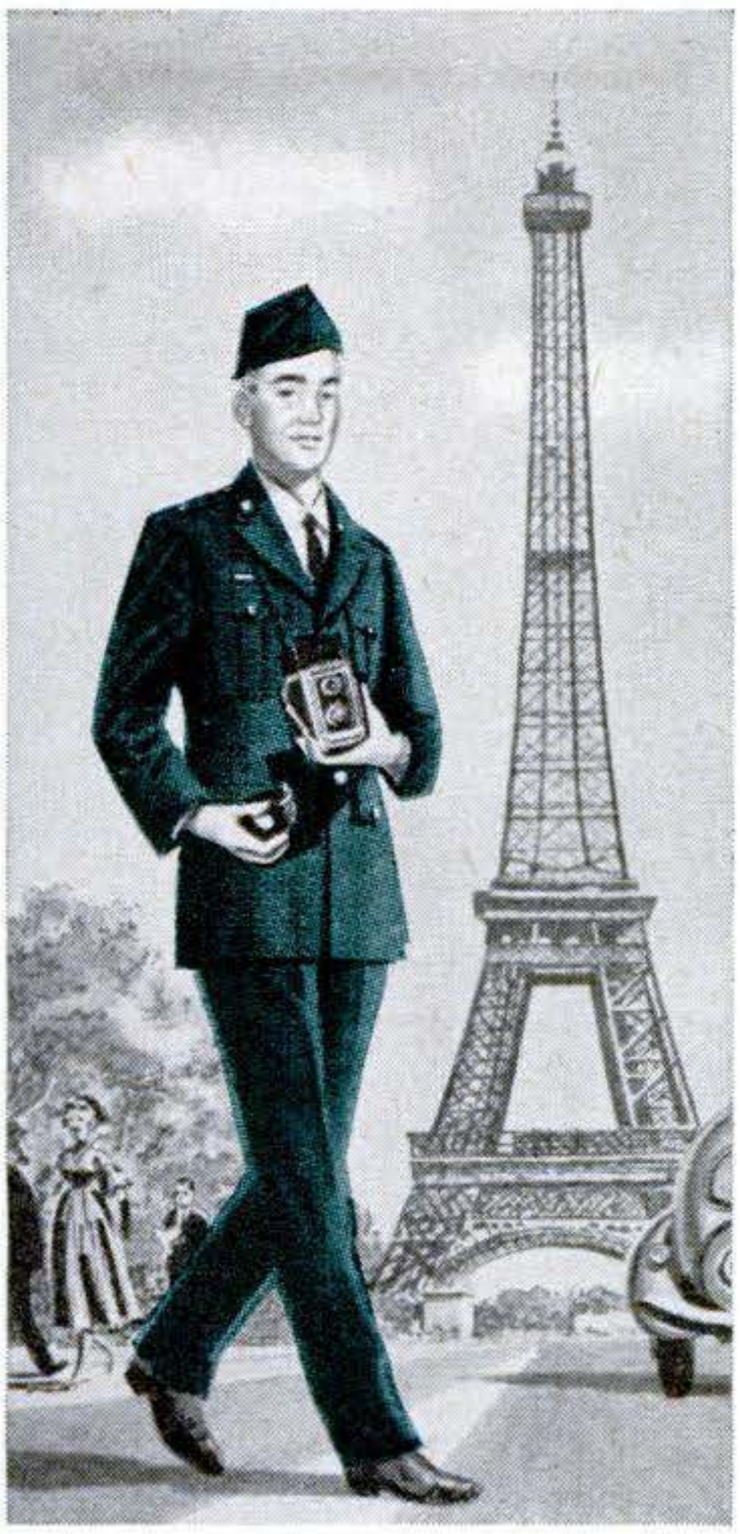

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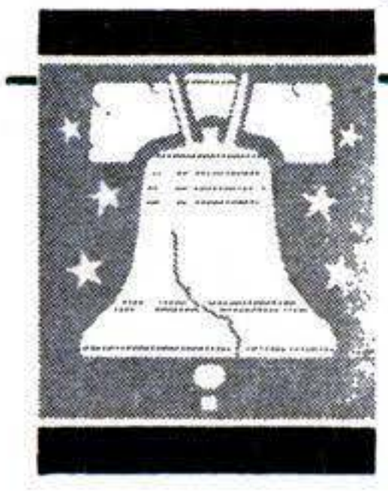

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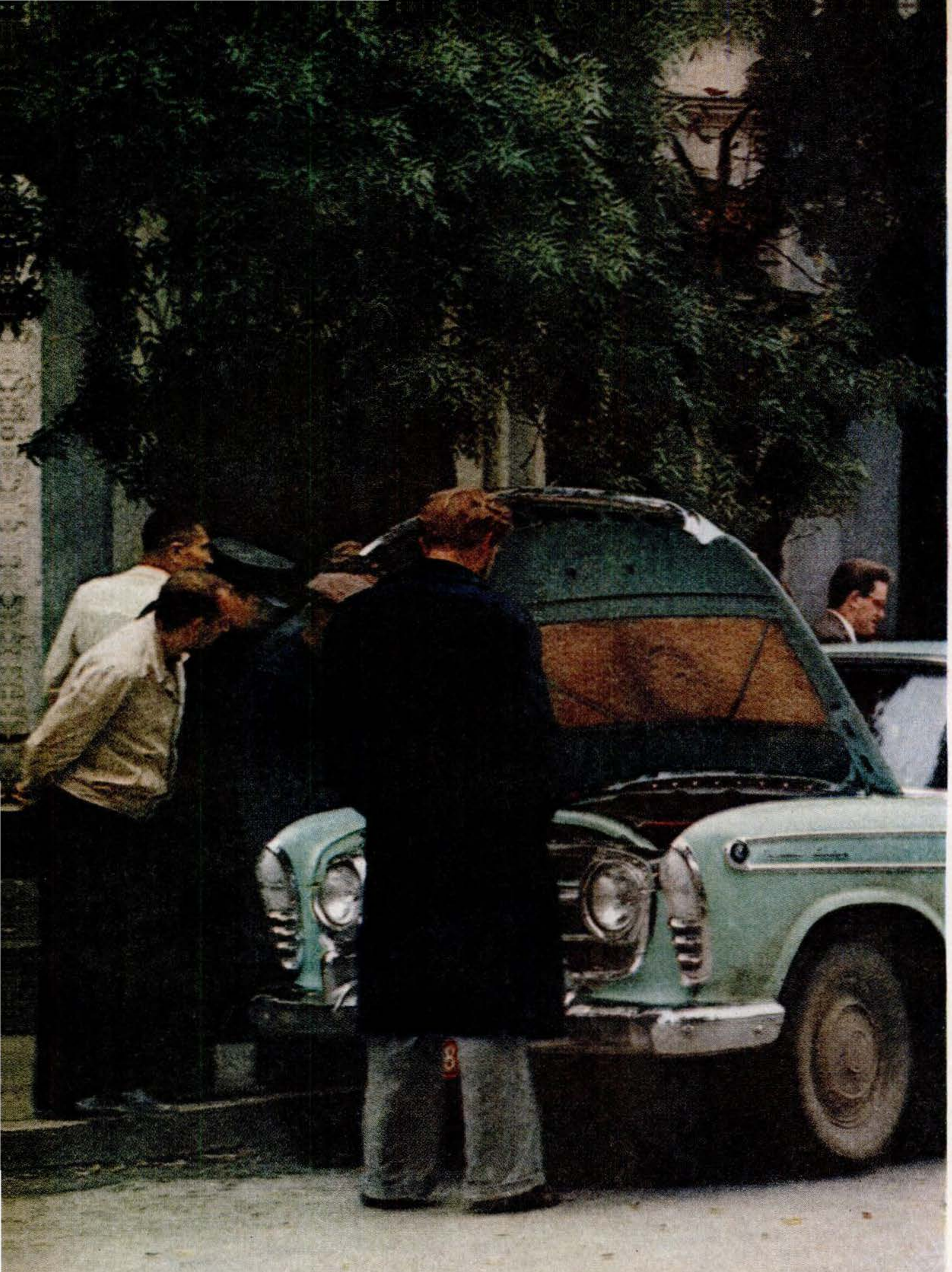

In Yalta as in every other city our American station wagon was a magnet for crowds.

POPULAR SCIENCE
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A POPULAR SCIENCE editor's uncensored report:

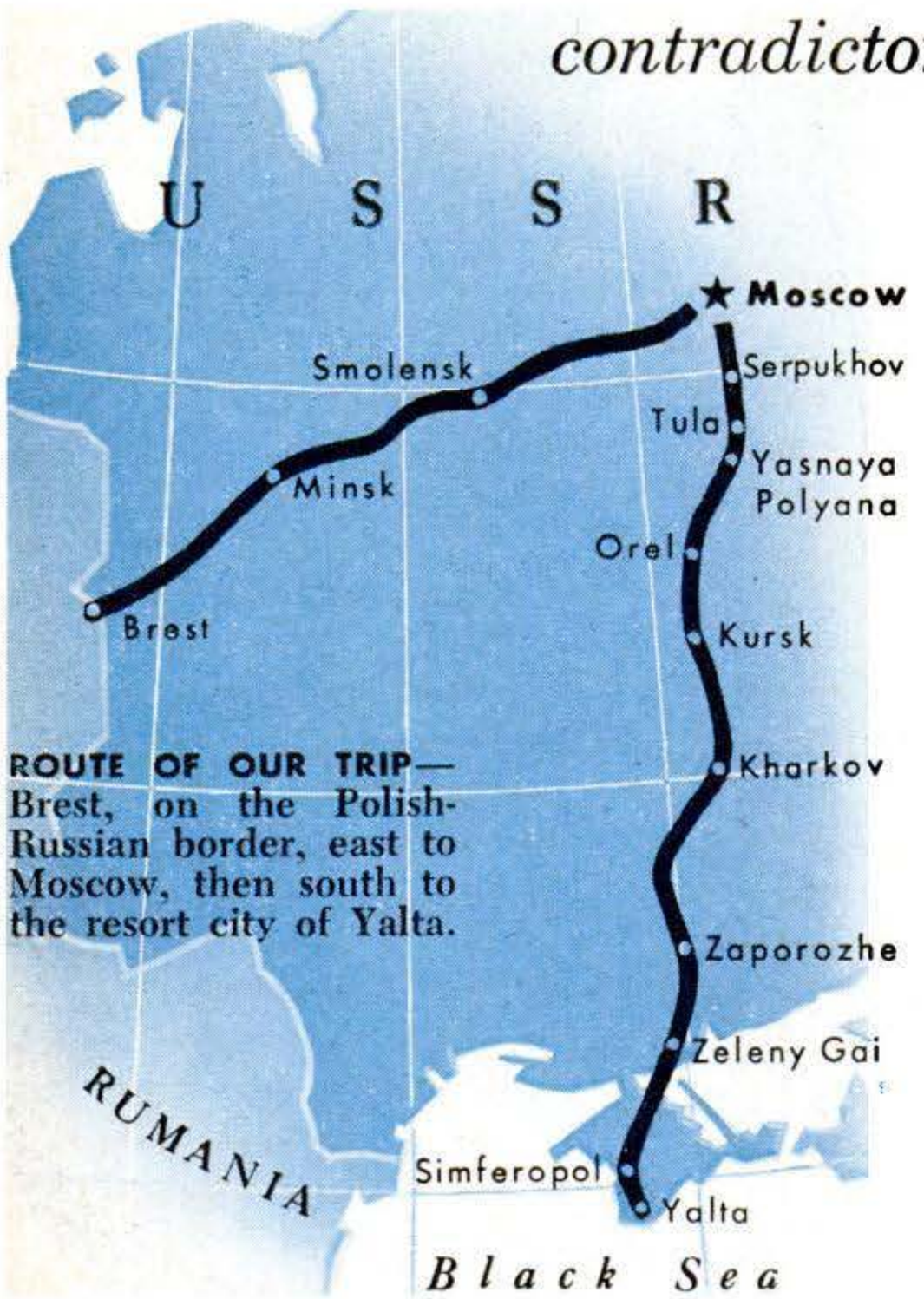
Inside Russia by Car

By Harry Walton

NOT another car was in sight as I pulled up at the loneliest border post I had ever seen. This was the beginning of an adventure into another world.

As the first American journalist to drive a U. S. car through the interior of the Soviet Union, my route would take me east to Moscow and south to the Black Sea—to such little-known cities as Kursk, Kharkov, Zaporozhe. Beyond, down the empty road that lay ahead, I was to find a strange and

"Ahead lay Soviet Russia, a strange and contradictory land . . . viewed through the



ROUTE OF OUR TRIP—Brest, on the Polish-Russian border, east to Moscow, then south to the resort city of Yalta.

contradictory land—one of broad highways and tiny hamlets, of grim national police and obsequious service, of women laborers and pretentious hotels.

Traveling with me was Dennis Michael O'Connor, a graduate fellow at the Yale Law School, who had a working knowledge of the Russian language. Our car was a 1957 Rambler station wagon.

Cold, wind-driven rain fell from a gray sky as we rolled onto the iron-railed bridge that spans the Bug River between Poland and the USSR. Even before we reached the Russian side, a rifle-carrying young Soviet soldier stopped us with a stiff military gesture. I tried speaking German to him. He shook his head. I offered him a cigarette. He refused it.

A sudden gust of wind blew my hat off, and instinctively I started after it. But I was not to enter the Union of Soviet Socialist Republics so informally. "Nyet!" barked the guard, and sprinted after the hat himself.

Shortly afterward a Pobeda rolled up, stopped smartly. A hawk-faced young Russian officer got out and checked passports. We were told to follow—and drove in the Pobeda's tracks to the Russian city of Brest-Litovsk.

At the railroad station, the car was immediately a focus for curious eyes. We followed an officer into a huge marble-walled waiting room. Through the windows we caught glimpses of handsome, bright-green railroad cars, occasionally heard the treble piping of a Russian locomotive.

In a high-ceilinged room upstairs we met our guide and interpreter, Valentine Salin, a soft-spoken, slight man with impeccable manners. Our new Rambler was due for an oil change, so we asked about a service station. We were led by the Pobeda through an iron gateway into a huge concrete yard. Promptly every Russian in the place came up to the car, and the questions began.

Nyet, not Angliski. Aftomobile Americanski. Nyet, not Ford or Chevrolet. Marka Rr—rr-rambler (the Russians roll that first "r" with the best of them). *Belgian plates because assembled in Belgium. Yes, new 1,951 kilometers ago.*

Eyeing the drain pit with alarm—it was a deep gash in the concrete floor, with hardly two inches of guard rail—I drove over it under the stare of 40 Slavic eyes.

While O'Connor held forth to a fascinated audience around the opened hood, I clambered down into the pit myself. My notion was to make sure the mechanic drained the engine, not the transmission, and kept the copper gasket on the drain plug. I needn't have bothered; he did.

"Aren't you going to start the engine before putting in new oil?" a Russian asked O'Connor. "It works better." O'Connor told him *we* didn't do it that way. There was a little flurry, as air was being added to the tires, when the hose fitting parted. Embarrassed at this technological lapse, three mechanics scrambled around to join it, finally in desperation held it together by hand.

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windshield of a U. S. car"

With goodbyes all around, we set formally off beyond the Iron Curtain. In the back seat was Salin—our guide, interpreter and (perhaps) private eye. I had an eerie what-am-*I*-doing-here? feeling.

My assignment was to drive 3,500 miles through Russia and report on how it differed from, say, a transcontinental U.S. trip. I started out with standard preconceptions: The roads would be terrible, the natives hostile, and I'd be in real trouble if anything broke on the wagon that couldn't be fixed by a tractor mechanic.

The preconceptions were wrong. The Russians I met were not hostile, and the roads and mechanics were first-rate. In several cities I met friendly, curious, wide-awake students, (including some who regularly read POPULAR SCIENCE in the technical library). Often I talked with earnest, unsmiling but not unfriendly adults who took to heart their government's much-repeated slogan: "Beat America." Everywhere I saw evidences of a dedicated national effort to cram into two decades the industrial revolution that has taken the West two centuries.

There is no speed limit in the USSR except through villages. The road east to Moscow is superb, more than wide enough for four cars abreast, with a well-maintained asphalt surface. Yet pedestrians, wagons and livestock made it imperative to reduce speed when dusk fell. In a land where the trucks rarely have working tail lights, you cannot expect them on cows. It is strange, too, that the country that first launched Sputniks hasn't given its bicyclists the humble but effective reflector button.

Tourists are privileged characters. In Minsk, we overlooked a no-passing sign and ran around a couple of trucks. Instantly an outraged militiaman (national police officer) thrust his baton downward in a gesture that would mean "pull over" in any language, and whistled us down, anger in every trill. We waited apprehensively as he stalked over. Our guide said a few words. The militiaman saluted and walked away. "You see?" Salin said imperturbably. "He apologized."

You can turn right on red in Minsk but are not supposed to blow a horn. It is wise to beware of the red circle that means no entry, or else you may find yourself driving down a flight of stairs. Most traffic signs, fortunately, are pictorial ones, easy for foreigners to get.

We stayed that night in a grandiose hotel with an elevator about four feet square. Inward-opening doors on the car made things comically awkward at times —two passengers with luggage become a crowd. Control is by pushbutton, with an operator to do the pushing—and you either learn the Russian for figures up to five, or resort to the childish alternative of holding up fingers.

Rooms are big, high-ceilinged, with enormous double-sash windows and often a balcony. Sometimes the beds stand in a curtained alcove. Rugs and drapes abound but lack the cool smartness of those in Western hotels. Bathrooms are crude affairs with asthmatic plumbing and primitive fittings. The huge bathtub and generous towels are often negated by a lack of hot water. You can use an electric shaver if you have an adapter for the round-pronged receptacles. The juice is 50-cycle A.C. at 127 volts—on which U. S. shavers are willing to function.

Formal sightseeing was encouraged always. In Minsk, we stopped at the Park Kultury (Park of Culture) to see something called the Children's Railroad. The name is misleading, for it is a very respectable narrow-gauge line with several kilometers of track, signals, a dispatcher's office, real cars and man-sized steam locomotives. But it is operated by six-to-14-year-olds, who have to qualify for the privilege. There is class instruction, too, to be sure that the youngsters absorb information with their fun.

Good as the highways are in this part of Russia, they're no expressways. Herds

Text continued on page 100 . . . Exclusive photos on next six pages

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Rolling country in the Crimea on the way to Yalta. Trucks are the workhorses of Russian

CO-EDS DIG A DITCH in the main street of Simferopol on their day of free labor for the state. Prettier than most women workers we saw, they made a lark of it. Russian women work hard, not only as breadwinners but in daily food shopping that may take two hours or more.

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highways. The kilometer post (in center, above) and guard posts are standard on main roads.

BALKY BOVINES BAR THE ROAD. But patience gets you through, sometimes with the help of the herder. Question: If a state-owned truck kills a state-owned cow, who sues whom? Or does the driver pay? Other roadblocks are slow wagons, unhurried flocks of geese and ducks.

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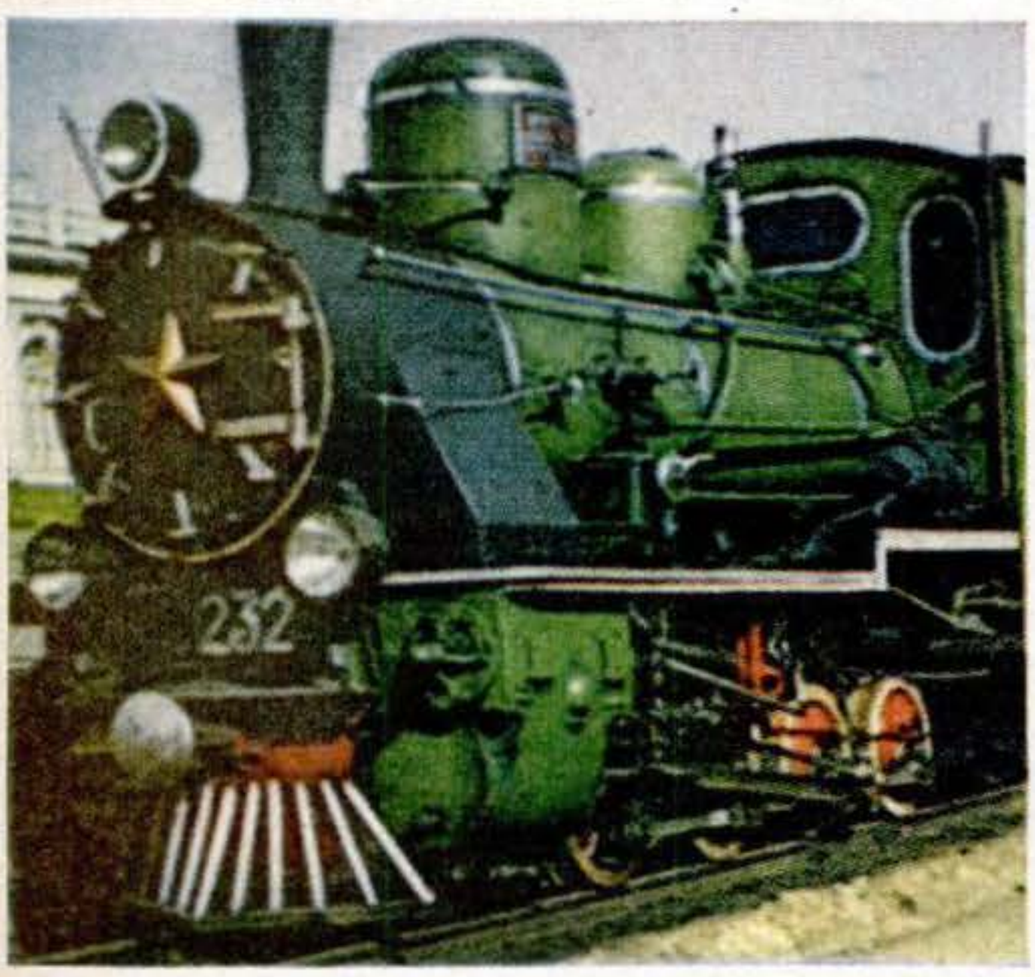
COLORFUL ROADSIDE MAP in New Zaporozhe pictures production goals in the Ukraine under the sixth five-year plan. Goods-hungry Soviet citizens feel they have a stake in statistics.

ENGINE OF CHILDREN'S RAILROAD in Minsk is no toy, but a 30-inch-gauge coal-burning steam locomotive. The kids' line at Kharkov is junking its oldest engine in favor of a new diesel.



IMPRESSIVE ENTRANCE to Industrial Exhibit is matched by displays of giant machine tools, tractors, trucks, cars and motorbikes inside. But waiting lists for new cars are years long.

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SEWER FOR SIMFEROPOL. A dragline shovel helps excavate for pipe. Co-eds digging elsewhere on this street asked why we didn't "shoot" the machine instead of them. So we did; here it is.

MOSCOW CROSSWALK. Traffic, squeezed right by posts that protect woman painting STOP on the pavement, waits for light at Gorki Street. Area at lower right is mid-street safety strip.

SUNLIGHT ON THE KREMLIN, and shadow on a Moscow street. Autos may be few, but walks are always crowded.

MAIN POST OFFICE in Moscow announces International Letter Week, urges Ivan to write his friends and relatives.

RED SQUARE with St. Basil's (left) and one of five starred Kremlin towers. At right is the Stalin-Lenin tomb.

School kids at Yalta look over our

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wagon, while one worried small boy and a curious blonde girl inspect the photographer.

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A soldier eyes the aftomobile Americanski. In this crowd at Kharkov, there's a station wagon

of plodding cows with no intention of yielding the right of way, trains of geese in stately single file, and both bikes and pedestrians wandering about unpredictably require a sharp eye on the road.

Then there are the flax threshers. I don't know what it's like to hit a foot-high layer of flax stalks at speed, because by luck we always slowed down in time. The women who sat by the road would wave us on over the stuff. After enough wheels have crunched it, the women pick the stalks out and make piles of the seed, which stays right there on the road until a truck comes along to pick it up. You aren't supposed to run over the seed—or hit the platform scale on the highway.

Road repairs are equally casual. Sometimes we encountered—hidden around curves, with neither sign nor flagmen to give warning—braking crises in the form of machines, gravel piles and work crews. The crews are predominantly female. Men drive tractors, dozers and rollers; the pick-and-shovel jobs are women's work. We even saw a railroad section gang of women. "Here," our guide explained, "they have equality."

Most motor traffic consists of olive-drab trucks with license numbers stenciled high on the tailgate. Some roll at 50 m.p.h., but many are slower. At crossroads, a driver who pulls to the middle of the road may (1) intend to swing wide into a right turn, (2) mean to turn left, or (3) simply like lots of room.

Russian drivers, of cars as well as trucks, are conscientious, actually, about signaling left turns on the highway. This they do by opening the left-hand door wide. Some even stick their heads out.

Our guide was apprehensive about overtaking trucks without warning. "Honk him! Honk him!" he would say tensely. Since outside mirrors apparently haven't yet been invented in the Soviet Union, this was good advice.

About overtaking America: There is no brand-name advertising on Russian roads—but there *are* billboards. The big posters and signs admonish the passerby to "Overtake America" or to "Work for World Peace." Others are exhortations to work harder, produce more, stop having accidents.

Directional road signs are big, clear and plentiful. Many include destination arrows that warn of turn-offs and show where they lead. Occasionally there is a big signboard strip map along the road (free gas-station maps are unheard of). Every kilometer along the main Russian highways is marked by a neat post with two mileage plates on it. One side shows the distance from Moscow, the other the distance from the provincial city at the far end. Concrete guard posts, drainage ditches, guard rails and warning signs are substantial and well kept.

Shy tourists should stay home, for any foreigner in the USSR is conspicuous, and one in a foreign car triply so. Our station wagon galvanized Russians into attention everywhere. Women stooping at work in the fields would straighten up to stare. School children plodding home at dusk from double sessions cried out in amazement. Whenever we pulled up on the road, people appeared from nowhere.

They all wanted to know the same things: what make the car was, how many cylinders the engine had, its horse-

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(note open hood). At right, O'Connor reads children's names written in dust on the Rambler.

power, and the gas mileage we got. Heavily loaded and cruising at 60 m.p.h., we were getting 9½ kilometers to the liter, a figure that greatly impressed our hearers. (Ours was obviously a bigger car than their Pobeda, which takes more gas.)

The price of the car, which Russians asked shamelessly and we told them gladly, impressed them as a great bargain. The Russian Volga, a much smaller car, costs 30,000 rubles—a whopping $7,500 at the official non-tourist rate of exchange, or three times the average worker's annual pay. Our Rambler delivered in Belgium at $2,600.

Between Smolensk and Moscow, traffic thickened, and I was surprised by the number of prewar American cars in sight —until a closer look revealed the ZIS or ZIM on the hubcaps. (The ZIM is a copy of an old Buick, the ZIS of a Packard.)

In rush hours, Moscow traffic flows at quite an alarming pace on the city's broad boulevards (I clocked taxis at 55 m.p.h.). Driving is a battle of wits between motorists and pedestrians, who pay no heed to lights. Since horns are prohibited, a driver's chief weapon is outbluffing the crowds. He who hesitates behind the wheel is lost—in a maelstrom of foot traffic.

Drivers are far more rigidly controlled than pedestrians. On many major intersections you can't turn left (an arrow pointing straight up means no turn at all; if it has a branch, you can go straight, or turn as indicated only). Where no left is permitted, you turn right and then make a U-turn in a designated gap through the midstreet safety zone. This works fine.

A sign with a red bull's-eye and an arrow pointing right means you wait to turn right on red. Some intersections have a row of four instead of three lenses in their traffic lights. The idea (and you'd better get it) is to wait for *two* greens to turn left.

It was time for a car wash when we reached Moscow. At the garage, two earnest, motherly little women in rubber boots and aprons took the Rambler in hand with spray hose and washcloths. Far too short to reach over the top, they flung the cloths up onto it and drew them down. When they were finished the car sparkled inside and out.

Russian mechanics, interested and helpful, made a new gasket for our leaky

SKOLKA? How many? The better, 74-octane gas was available only at a few special pumps.

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jerry-can spout. But when I asked for an antifreeze hydrometer, they could only shrug their shoulders—and taste the stuff in the radiator instead. Savoring the coolant, they said it hadn't much antifreeze.

Every truck in the USSR seemed on its way south when we took off on the long haul for Yalta. To cover the long distances we drove after dark. Rolling country made night driving tricky; just over the crest of a hill often lurked a lightless wagon. Truck breakdowns seemed to call for conferences and repairs well out on the road, without flare or lantern to serve warning. But worst of all was the problem of dimming our own headlights. Even on low beam, they invariably provoked an angry blinking of lights from oncoming traffic. Finally it dawned upon us that on approaching another vehicle we were not supposed to lower the beams, but to turn the headlights off entirely, driving by moonlight —if any. This may work with slow trucks; it puts a fast car in serious danger of hitting an unlighted obstacle.

Everywhere is the alert militiaman—not only at crossroads and in hamlets, but also standing on many a lonely country hilltop. Sometimes he has a motorcycle sidecar, complete with burp gun. The militiaman is cop, judge, court clerk all in one, for in the USSR, traffic court is held right on the road. Drivers who violate a traffic law pay their fine on the spot. The officer gives the offender a receipt and punches his driving license.

The third night of our trip south we

How Communism Threatens Russian Science

Condensed from "A Report on Science in Russia Today" by Dr. Tom Margerison, scientific editor of the British magazine The New Scientist, *who visited Russia about the same time as* POPULAR SCIENCE'S *Harry Walton.*

NOBODY who visited Russia without prior knowledge of her prominent position in science would dream that a country in which petty officialdom and inefficiency are still so evident could beat the world in the launching of earth satellites. Scientists are now probably the most pampered profession in Russia. They receive salaries as high as, or higher than, leading artists of the stage and screen.

The result is that there is great competition to join their ranks. The universities are inundated with students wanting to study science subjects. The prizes of an assured position, a salary sufficient to buy a car, and other comforts, spur the students to hard work.

One rather sinister fact about the education of Russian scientists is that at every stage in their career they are required to prove their competence in the Marxist-Leninist doctrine. Entrance to a university is reserved only for those who can pass their political examination. Entrance on a postgraduate course depends on the results of yet another political examination.

Trying to arrange a visit to a laboratory or research institute involves a series of tussles with officialdom. Inside, I might have been in any British university laboratory—but for the red banners, carrying Communist Party slogans in celebration of the fortieth anniversary of the revolution, plastered bizarrely across the walls.

Basic research in the Soviet Union is carried out mainly in the laboratories and research institutes of the Academy of Sciences, and of the 13 provincial academies. The budget for each institute seems to be flexible and, provided the Academy agrees, there is little difficulty in obtaining additional money for special projects.

The Academy thus wields very great power. Recently, it has been stressing the unity of the Party and the scientists, and has, apparently, been attempting to increase political activity among the scientists.

A. Topchiyev, the secretary of the Academy, said recently in an article in *Kommunist:* "To fight idealistic views and trends, tirelessly to expose idealistic conceptions, is the duty not only of representatives of the social scientists but also of scientists working in all spheres. We must energetically rebuff all revisionists of the Marxist-Leninist teaching. . ."

If this nonsense, written by one of the most influential men in the Academy, is to be taken seriously, it means that the future of Soviet science is less bright than most people believe. It means that the Communist Party is trying to set foot in the laboratories and gain control of them in the same way that it has been doing in the armed forces.

Science cannot be conducted in this way, and I am sure that the majority of the Russian scientists realize it.

Three things have brought Soviet science to its present thriving state. First, the government is prepared to spend money on it. Secondly, it gives scientists the privilege of a higher standard of living and greater freedom of movement than most other people. Thirdly, the scientific secretaries and administrators form a barricade inside which scientific thought flourishes without concern for the party line.

It looks as though this barricade may soon be swamped. If things go on in this way we may yet see a marked decline in the standard of Russian science.

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Moscow's Manezh Square on a rainy day, Historical Museum and (top right) part of Kremlin.

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stopped at what Salin, our guide, said was a resort hotel. (O'Connor, surveying the plumbing, dubbed it the Last Resort.) Zeleny Gai is a stop for the big through buses, diesels, that roll from Moscow to Simferopol with two relief drivers and loads of sober-faced Russian vacationists aboard. The hotel, only six years old, was already shedding plaster, and the plumbing was deplorable.

The road runs arrow-straight for miles south of Zeleny Gai. Looking at the rolling wheat lands, you could imagine yourself in the American Dakotas, until you ran across a knot of long-skirted, quilt-coated farm workers waiting for a bus or holding out a hand, palm up—a startling gesture that turned out to be the Soviet version of the hitch-hiker's thumb.

CAR WASH IN KHARKOV: This Intourist chauffeur hosed down the Rambler in the hotel yard.

Gas is where you find it in the USSR. And not just any gas station will do. Most dispense a low-octane juice as full of pings as borsch is of cabbage. We had to use it just once, and to the Rambler's eternal credit it swallowed the stuff, protesting mildly.

The "high-test" gas is 74 octane, available only from certain pumps in specific stations—and possibly only to tourists. On this the car ran fine; for we had asked the Brussels assembly plant to detune the engine to take it.

For those occasions when the special pump wasn't working or the tank was empty of 74-octane, we carried 20-liter jerry cans. They came in handy a couple of times, making it possible for us to go on rather than accept the liquid horrors that satisfy Russian engines.

Gas pumps (which, for some reason, you aren't supposed to photograph) are ancient, dirty, usually hand-operated. Some were made in Germany, possibly before World War I. As the operator works a pump lever, gas flows into one of two glass flasks, while the previously filled one drains its measured volume into the car.

From Simferopol to Yalta is only 100 kilometers, but the road climbs two mountain ranges and snakes through a valley between them. The highway narrows down, with some widening at curves, but shoulders drop off into gulleys and driving is a matter of sawing the wheel continuously, with hardly 300 feet of straight stretch anywhere.

What had been drizzle turned into rain as we began to climb. Clouds wreathing the peaks had descended as fog, so that we reached the city, a maze of narrow one-way streets, late, tired and irritable.

By daylight the mountain drive back north was easier and the scenery magnificent. In Simferopol a huge ditch down the main street was being filled in by some 30 good-looking girls, rather awkwardly wielding picks and shovels. When I produced a camera, they glowered and turned away. They were college students, giving a day's labor to the state. Perhaps they were unwilling to have a foreigner photograph what they thought might be construed unfavorably—or, more likely, plain female vanity was at work.

Farther north, we ran across evidences of private enterprise: women and children selling melons along the highway. As we passed a road-repair crew, a young woman bellowed enthusiastically at us. I asked what she had said. O'Connor translated: "What a car!"

To Russian officials, the Rambler was evidently a source of embarrassment. We were repeatedly asked to park it out of sight behind locked gates. In Kursk, a militiaman appealed to a large crowd: "Comrades, don't just stand here looking at this car. You have work to do. And you children should be going to school. Move on." Nobody budged—it was the militiaman who rather sadly moved on.

Outside a tiny village north of Zapo-

[Continued on page 234]

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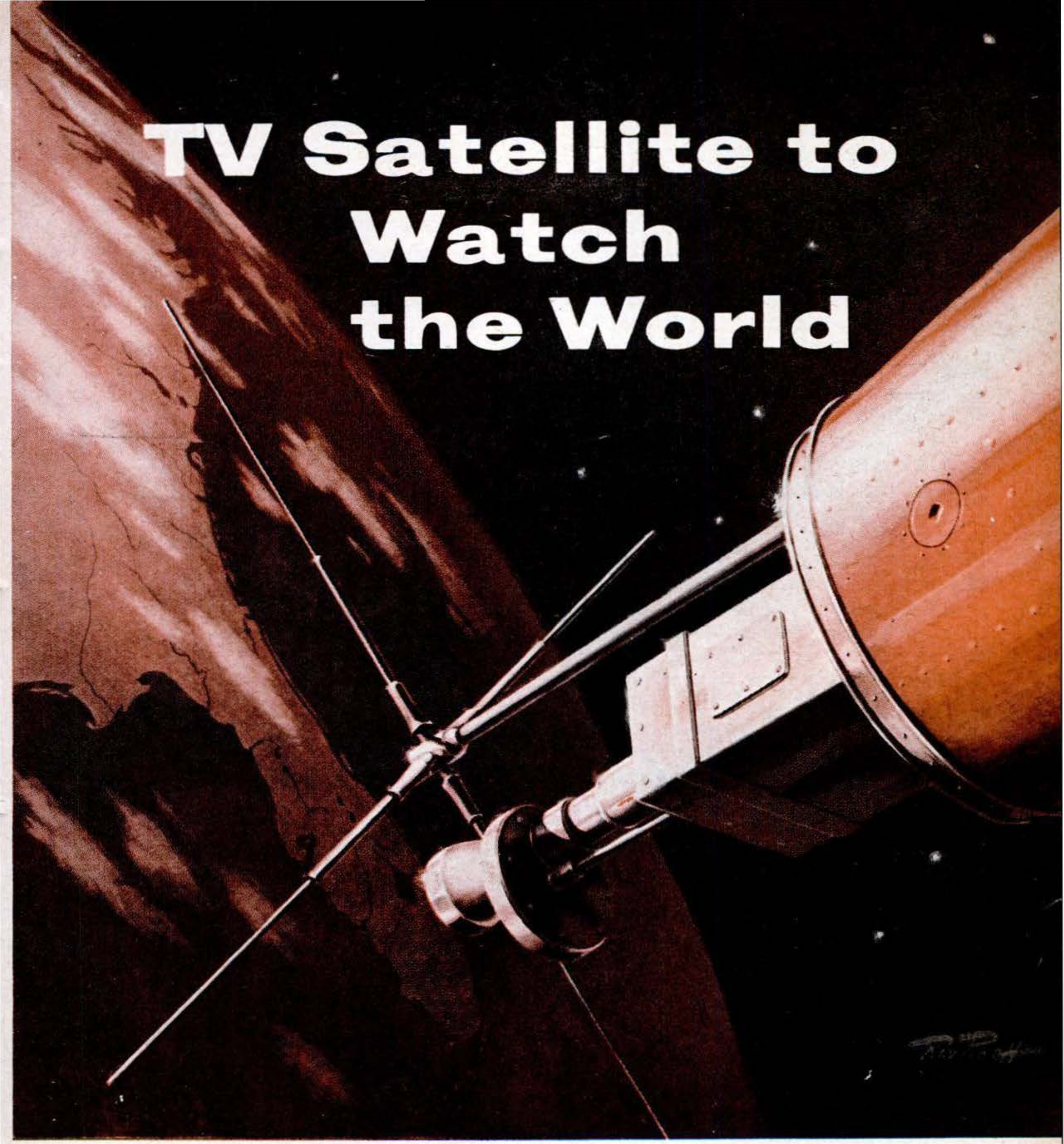
TV Satellite to Watch the World



U. S. scientists tackle the immense problems of launching a globe-girdling, "seeing-eye" satellite. Target date: any time

By Wesley S. Griswold
DRAWINGS BY RAY PIOCH

IN THE wake of Russia's Sputniks and our own Vanguard procession of space travelers, the U. S. is planning to shoot an electronic eye into the sky. This reconnaissance satellite, girdling the globe every hour and a half at a height of 500 miles, will be equipped to take pictures of the whole world.

The seeing-eye satellite, designed to acquaint us with many activities to which we are now largely blind, is officially called Pied Piper. Unofficially, and much more aptly, it is called Big Brother. That

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was the name of an all-seeing, all-hearing world dictator in George Orwell's prophetic and chilling novel *1984*.

The secrecy shrouding details of Big Brother is as hard to penetrate as that which hides the goings-on in the Kremlin. It has been reliably reported, however, that Lockheed Aircraft Corp. has been assigned to build the satellite and the multiple-stage rocket vehicle to transport it, that CBS and Eastman Kodak have been given the task of enabling it to see, and that Rocketdyne, a division of North American Aviation, and Aerojet-General Corp. will provide the mighty engines to boost it into its orbit.

When may we expect Big Brother to start giving us passing glances from 500 miles above? According to Air Force insiders: any time. Since the Russians are known to be at work on a similar project, Big Brother's debut will be speeded up.

What are some of the problems that must be solved before we can launch a reconnaissance satellite? What will it see?

I sought the answers from many working scientists, not all of them willing to be publicly identified. Here are the questions I asked and the answers I got:

Do we have rocket engines powerful enough to lift Big Brother into place?

That depends on how much it will weigh, and nobody close to Big Brother is giving out any figures. However, there have been educated guesses that a satellite weighing around 100 pounds *could* carry a small TV camera, miniaturized transmitter and their source of power.

Do we have rocket engines capable of heaving a 100-pound satellite into an orbit?

Indeed we do. A quick way of estimating the capacity of the engine needed to do the job is to apply this rough rule-of-thumb: For each pound of satellite, you need 500 to 1,000 pounds of thrust. Even the original German V-2 developed 56,000 pounds of thrust.

"We now have rocket engines with many times the thrust of the V-2," said Paul R. Vogt, assistant chief engineer of Rocketdyne, which builds engines for the Atlas, Jupiter, Thor and Redstone missiles. "And there is no basic limit to the size of rocket engine that can be built."

We could have fired a rocket to the moon before now if we had had a good reason to do so. Maj. Gen. Bernard A. Shriever, head of the U. S. intercontinental-ballistic-missile program, has said that Atlas' power was sufficient to drive a payload of *several thousand* pounds beyond the pull of the earth's gravity. But sheer rocket power is not so important as the efficiency with which it is used in a particular vehicle.

Can we build a useful reconnaissance satellite that will be light enough to be put in an orbit?

"It would take a marvel of miniaturization," said John A. Burrell, manager of technical operations for NBC's Western Division. "It's conceivable, of course, that with the use of transistors you could make a very light camera and a synchronizing generator that would weigh only 10 or 12 pounds.

"What about optics? The wider the angle of lens, the smaller and lighter the lens will be. But the broader the view, the less detail you'll get in your picture. Assuming that we'd want to magnify what the TV camera sees, we'd have to use heavier, longer lenses. There would have to be some means of stabilizing the camera in space, and servo-operated equipment, remotely controlled, to swing it, keep it trained on the earth and adjust its focus. That would greatly increase the satellite's load.

"The real bind, though," Mr. Burrell said, "would come in trying to get a microwave transmitter small enough and yet powerful enough. The smallest suitable transmitter I know of weighs at least 1,500 pounds. Even assuming some genius could miniaturize this to 150 pounds, you'd need 1,500 to 2,000 watts of power to send a good video signal back to the earth from a height of 500 miles."

This estimate of the needed power—a figure all-important to choice of power source, and hence to the whole design—is much higher than some. For instance, as little as 100 watts was recently suggested as sufficient for a TV space vehicle by Prof. S. F. Singer, University of Maryland physicist.

What kind of orbit would a reconnaissance satellite have?

If it is to see *all* of the earth at one time or another, and not just part of it, its carrier rocket will have to be launched at right angles to the equator. Thus the rocket will need more power and be harder to aim than Vanguard's rocket, which,

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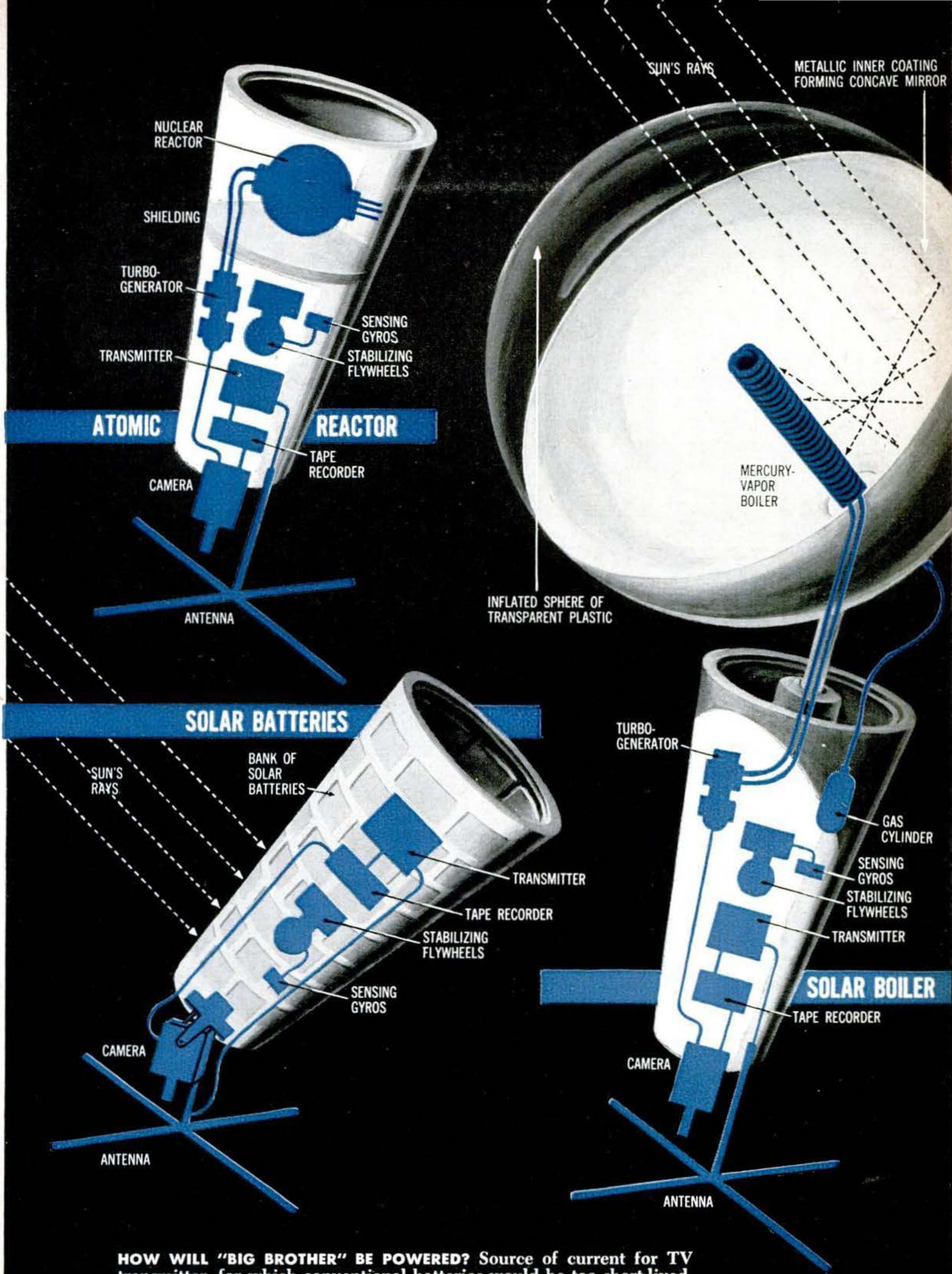

HOW WILL "BIG BROTHER" BE POWERED? Source of current for TV transmitter, for which conventional batteries would be too short-lived, will determine satellite's outward appearance. Sketches suggest three possibilities open to scientists: a nuclear reactor; solar batteries; or a solar boiler, shown as a composite of several proposed designs.

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"It could watch and direct a guided missile unerringly from the launcher to a target

launched eastward from Florida, gets a 900-m.p.h. boost from the earth, traveling in roughly the same direction.

What will Big Brother be able to see?

"Once the reconnaissance satellite is on the wing," says Dr. Heinz Haber, noted physicist and space scientist, "meteorologists will be able to watch cloud formations and the origin of major storms. Cold and warm fronts, squall lines, thunderstorms, hurricanes and tornadoes can be followed up and their courses predicted.

"We are still pretty much in the dark as to how the huge weather machine works," he continued. "The glassy eye of a TV camera in space can soon tell us how to save countless lives and dollars that violent, unexpected changes in the weather now wipe out."

Will the seeing satellite be able to detect objects smaller than countries and vast cloud formations?

It should be able to see ships and planes, detect forest fires and watch the wanderings of icebergs, Dr. Haber believes. His thoughts are entirely of its peaceful, beneficial applications. He sees it especially as a marvelous aid to transoceanic traffic control, both on the surface and in the air.

But won't it have great military value, too?

Some scientists think so. And military men think of the satellite primarily as a means of taking frequent looks at a potential enemy's territory—200,000 square miles at a glance. They believe it will be able to spot troop and fleet movements almost as soon as they start. They believe it could watch and direct a guided missile unerringly from the launcher to a target thousands of miles away. They are confident that it will detect atomic tests, the construction of airfields and big industrial plants. It will be an invaluable means of remapping the world, with greater accuracy than has ever been possible before. It will pinpoint the locations of bases whose whereabouts are not known precisely now. Even if cloud cover or darkness should hide these vital installations during a few of Big Brother's flybys, they will be caught in full sunlight sooner or later.

How could we power a TV transmitter in outer space?

The most obvious source is the sun. But solar batteries at their present stage of development are weak. They could supply a very modest amount of power, which might be adequate if a TV transmitter could be operated on as little as 100 watts. But if it called for the higher estimate of 1,500-2,000 watts, the required number of solar batteries would be of prohibitive bulk and weight.

Dr. Wernher von Braun, renowned authority on rockets and the problems of space travel, suggests a solar boiler. He proposes a system of concave mirrors with little mercury-filled pipes attached to them. The mirrors would catch the sun's rays and the mercury would carry off the intense heat to run electrical generators. These, he estimates, would develop 12 kilowatts of power, a generous supply for a reconnaissance satellite. Whether such a design could be kept within a reasonable weight limit is problematic.

Could we use nuclear power to run the satellite's transmitter?

It seems difficult; though a reactor only a foot in diameter, containing four gallons of fissionable material, has been built. Even the tiniest practical reactor would have to be teamed with a heat exchanger and a generator in order to produce electricity. This would be a heavy combination for the satellite, even if shielding were left off the reactor. Another problem: Radiation from an unshielded reactor might injure the satellite's TV equipment even though, at a height of 500 miles, it would be no threat to humanity.

What will Big Brother look like?

It will probably be the final stage or nose cone of the carrier rocket. Its TV eye might be set in the tip of its nose. The lens can be protected during ascent by a ceramic cap, to be blown off by a small explosive charge when Big Brother arrives in its orbit. Or it might prove desirable to have the lens in the middle. Small flywheels, von Braun suggested,

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thousands of miles away"

could keep its eye fixed on the earth.

Would Big Brother have a radar scanner?

At that height, no present-day radar could provide meaningful pictures.

How are we going to receive television pictures that the satellite has taken on the opposite side of the world?

They will be automatically stored on magnetic tape—already used to record TV programs. Then, when Big Brother swings into sight and range of our recieving antennas, a radioed command will start the tapes transmitting what the camera saw half a world away.

Would it be possible to jam telecasts from the satellite?

Yes. It is far easier to track down and interfere electronically with TV transmitters than with radio transmitters.

Will it be feasible to use film-carrying cameras on Big Brother?

So far as the actual picture-taking is concerned, yes. It would not be much harder to take unblurred shots of the earth from a vehicle traveling 18,000 m.p.h. at a distance of 500 miles than it is to take them from a jet plane flashing over the landscape at treetop height. Sharp, detailed photos have often been obtained from low-flying planes moving several hundred miles an hour.

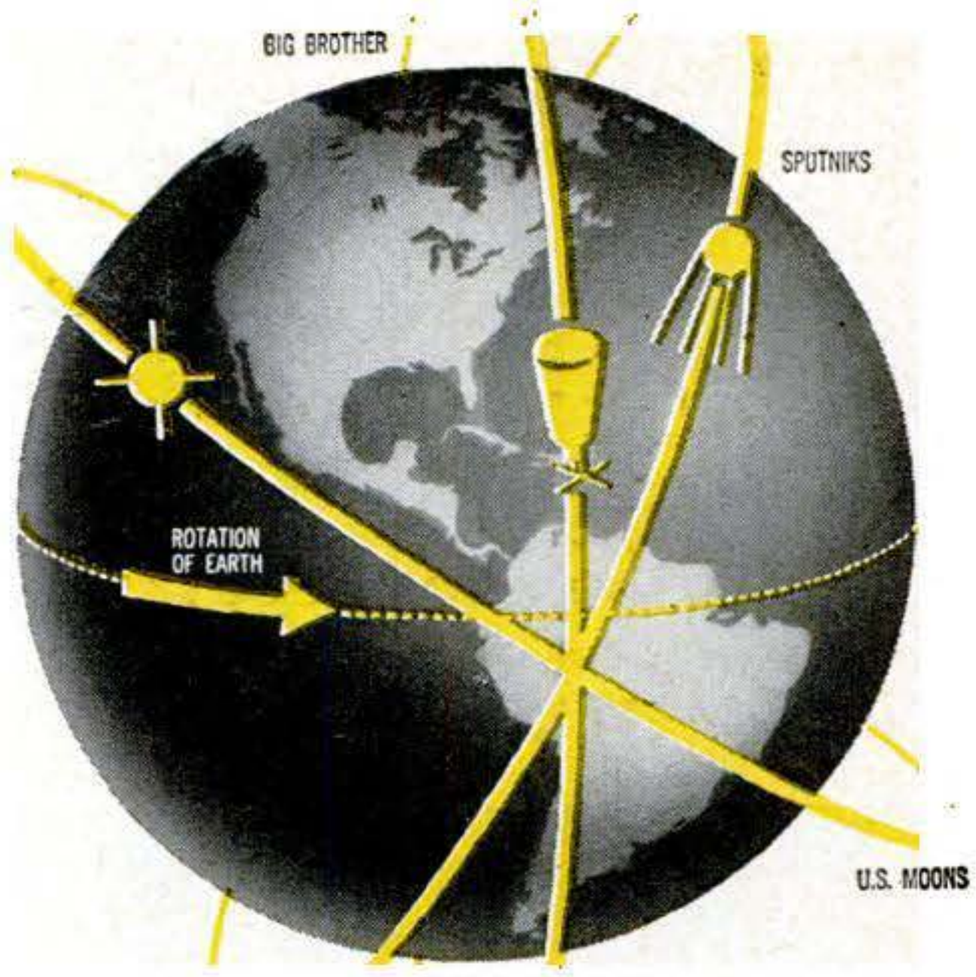
The acute problem would be that of retrieving the exposed film. If it can be detached and sent down (i.e., slowed and put in a "decaying orbit") without being incinerated by the friction of its fall to earth, there still remains the job of finding it when it lands. After that comes the puzzle of how to load fresh film up there.

Could Big Brother take infrared pictures at night?

Not now, and not from that height. Infrared photography hasn't yet been made effective enough.

Wouldn't tiny meteorites pit and cloud the lens of a satellite's camera?

Probably, though it might take quite a while for them to interfere seriously. Besides, there is a relatively simple way out of this difficulty. Dr. Haber suggests making use of a camera with rotatable lenses and with a photocell to warn when a lens is becoming even slightly obscured. The photocell could then trigger a mechanism to rotate a new lens into place.



POLAR ORBIT of "Big Brother" satellite, contrasted with less-far-ranging orbits of Russia's Sputniks and of U. S. Vanguard "moons," will let it view entire surface of earth.

What will a reconnaissance satellite mean in international relations?

Obviously no nation will stand for this kind of snooping unless it has the right to reciprocate—or unless it doesn't know.

A reconnaissance satellite might be painted dead black and launched secretly, without radio beeps to give itself away and with its orbit known only to its launcher. It might conceivably take its pictures in secret for a long time. But once it was discovered and its orbit plotted, it could quickly be put out of commission—not by an atomic bomb but by buckshot!

The indignant nation that found it out need only prime a rocket with a big load of lead or steel pellets and a small explosive charge and launch it into the same orbit with the satellite, but headed in the opposite direction. This could be done on the opposite side of the world, with the charge set to explode a quarter-turn away from its target. Thenceforth, on each successive wheel around the earth, snooper and shot would collide at an impact velocity of around 36,000 m.p.h. It wouldn't be long before the satellite was reduced to a cloud of metal shreds, circling the earth aimlessly. END

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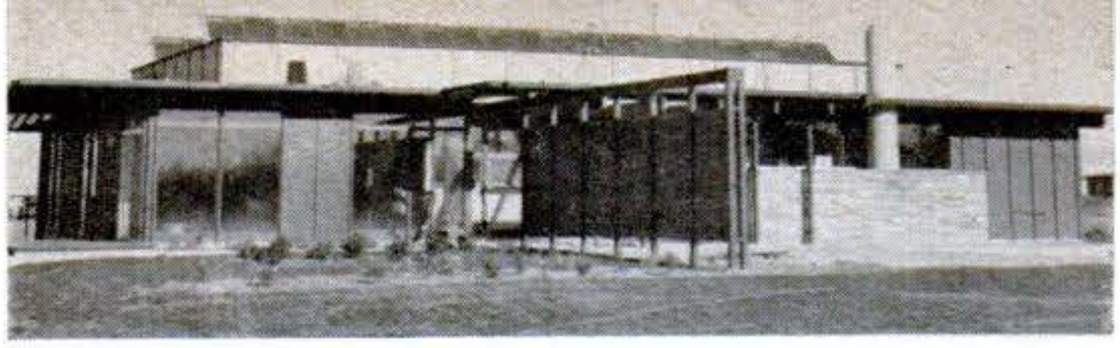
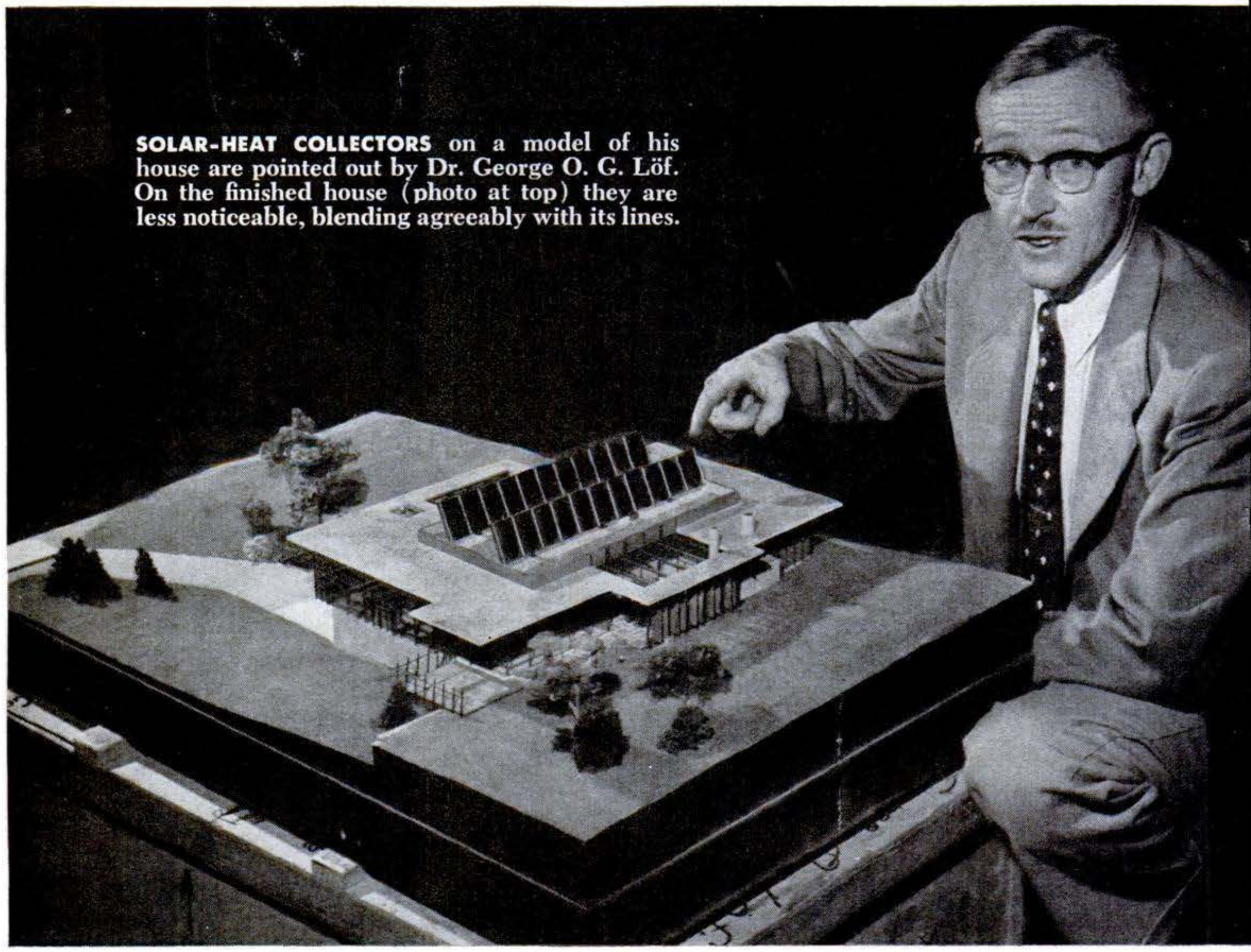


Will Your Next House

Here's a man who keeps his house warm with a factory-built solar-heat system that forecasts fuel savings of 80 percent



SOLAR-HEAT COLLECTORS on a model of his house are pointed out by Dr. George O. G. Löf. On the finished house (photo at top) they are less noticeable, blending agreeably with its lines.

ONE clear, cold day early this winter, I walked into a cozily warm nine-room house in Denver and learned an amazing fact. At that very moment, the heat so comfortably abundant in the big new contemporary home was costing the owner of the place absolutely nothing. The sun, pouring unlimited energy upon eastern Colorado, was providing every last calorie of it.

A few minutes later, it did even more. It began to supply the house with surplus heat, to be stored for use that night.

I *heard* it happen. I was standing beside the conventional-looking furnace, in a basement area not noticeably different from any other modern utility room. Suddenly a switch clicked, a damper closed with a metallic exclamation, and the electric blower in the hot-air heating system began to work twice as hard.

My host, Dr. George O. G. Löf, a con-

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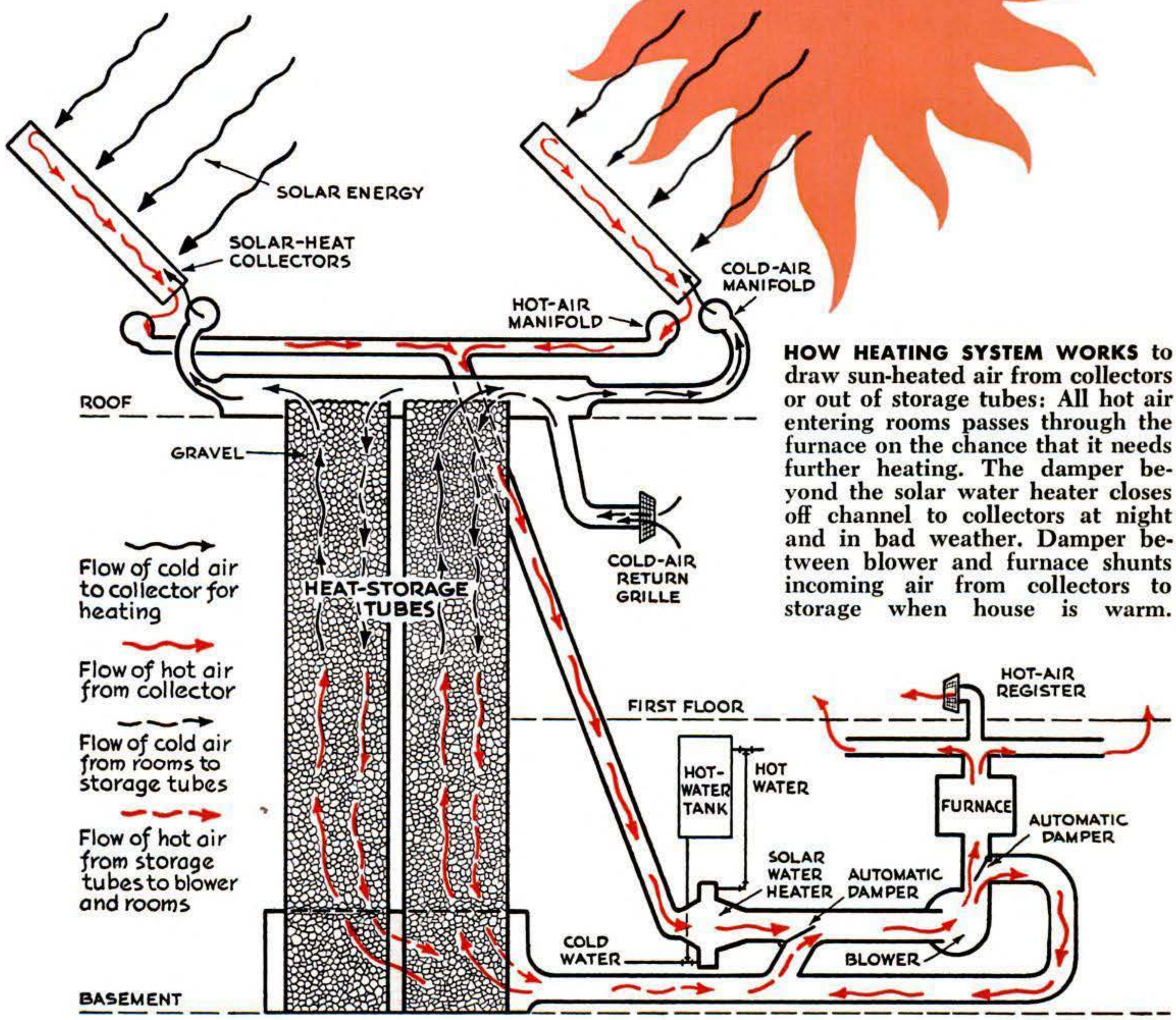
Get Its Heat from the Sun?



HOW HEATING SYSTEM WORKS to draw sun-heated air from collectors or out of storage tubes: All hot air entering rooms passes through the furnace on the chance that it needs further heating. The damper beyond the solar water heater closes off channel to collectors at night and in bad weather. Damper between blower and furnace shunts incoming air from collectors to storage when house is warm.

sulting engineer, turned to me with a pleased look. "The house has got all the heat it wants right now," he explained. "Since the thermostats aren't calling for more, the sun-heated air from the collectors on the roof is automatically being shunted into storage."

Dr. Löf, a tall, lean, red-haired man of 43 who is a solar-energy expert of international reputation, had a right to look pleased. He had designed the novel and efficient heating system. American Window Glass Co., of Pittsburgh, for whom Dr. Löf is a research consultant, built it.

The Löf home—a lively household of two adults, four energetic youngsters and a black cocker spaniel—is not, of course, the first in the U. S. to be heated by the sun. There have been at least half a dozen others—all odd looking, because they were primarily outsize collectors of solar energy

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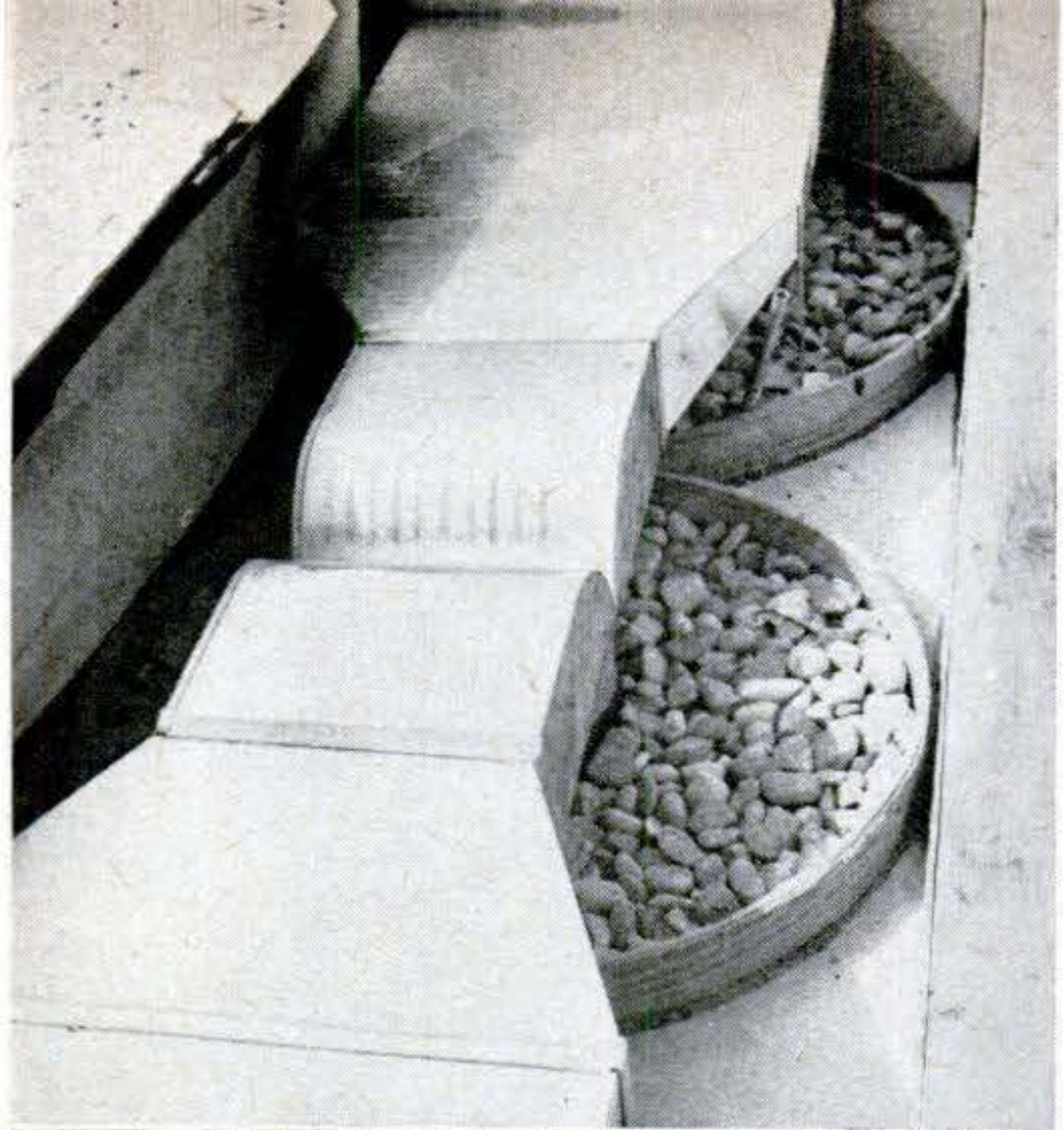
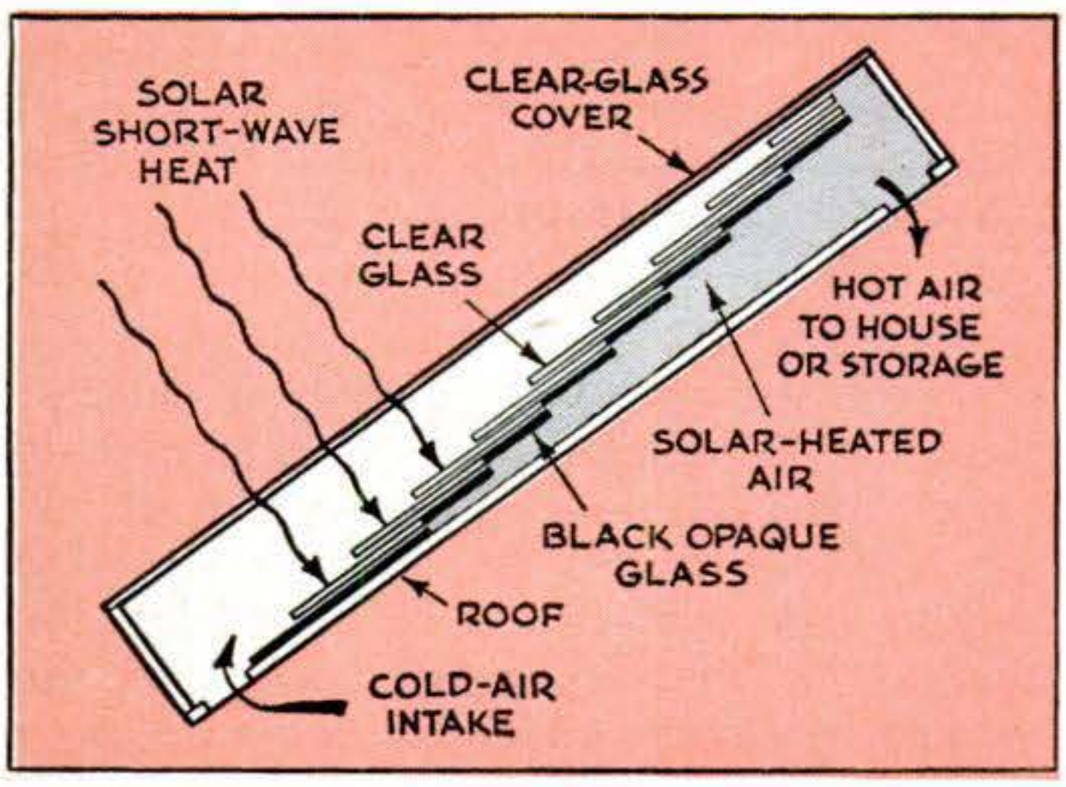


SURPLUS SOLAR HEAT is stored in these two 16-foot, house-high tubes. They are filled with 10 tons of coarse gravel. Rooftop view (top) shows how air ducts and storage tubes connect.



OVERLAPPING GLASS PLATES within collector panels trap sun's heat. Solar "furnaces" on roof are 50-foot aluminum frames holding 20 panels, each measuring six feet high, 2½ feet wide.

with living quarters attached to them.

But the attractive residence of the large and happy Löf family is unique in two respects: (1) It is the first American house to have a solar-heating unit as optional equipment that didn't dictate and distort the design of the house to suit its needs. (2) Its solar-heating unit was the first to be factory-made.

Thus the Löf home may very well make housing history. It represents a decisive step away from the laboratory toward the day, perhaps five to 10 years from now, when solar-heating will be the most practical kind for thousands of homes.

If your eyes weren't searching the rooftops, as mine did, for signs of solar-heat collectors, I don't think you would very quickly single out the Löf's $40,000 house from among its comparably expensive neighbors in Cherry Hills Village, a suburb southeast of Denver.

That large, low, square enclosure on the roof, seen from a distance, might easily be mistaken for a sun deck. Even at close quarters, the two long aluminum frames of glass panels that stretch across the roof enclosure, parallel and a few feet apart, aren't scene-stealers. They don't protrude very far above its rim, because they face the south at an angle of 45 degrees, to catch the maximum amount of energy from the low winter sun.

Each panel in the collectors contains several plates of specially treated, nonreflective glass, partially overlapping but with quarter-inch air spaces between them. As the radiant energy of the sunlight strikes these glass plates, heat is trapped between them. Panel temperature, even in winter, may rise to 250 degrees F.

Then cool air from the house, pushed up there through ducts by the blower in the basement, enters the collectors and is blown through the narrow passageways between the plates of glass. The moving air "wipes off" the heat and carries it either to the rooms below or into storage.

The collectors don't demand housekeeping attention. Snow slides off them of its own weight, and atmospheric dirt, in the clean air of Denver, doesn't accumulate on them enough to lower the efficiency of the collectors' glass.

Inside the five-bedroom house, expansive in looks and spirit, bright with picture windows, there is only one evidence of the unique heating system.

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In a broad, oak-paneled stairwell leading to the basement from just inside the main entrance stand two massive Chinese-red tubes, 16 feet tall, three feet in diameter. They are majestic in simplicity and size. Behind the stair landing, they stretch from cellar to roof. These are the storage chambers for surplus solar heat. Though you wouldn't believe it until you touched one, they are made of fiberboard, and they are filled with thousands of small chunks of rock. This coarse gravel holds the heat as long as 24 hours.

It was the architect—James Hunter, of Boulder—who wisely suggested that the Löfs not try to disguise the storage chambers, but paint them a vivid red. It glows warmly against the oak walls.

When the collectors on the roof are gathering more heat than the house needs at a particular time, the excess is forced into the storage chambers at the bottom. (The furnace blower speeds up to do this job in order to overcome the resistance of those columns of rock.) This naturally drives off any cold air at the top of the storage chambers, pushing it along into the collectors to be heated and then returned to the other end of the tubes.

At night or on cloudy days, the solar collectors are bypassed. Then, whenever the room thermostats signal for more warmth, the blower draws stored solar heat out of the storage tubes from the bottom. This warm air is blown through the furnace, where, if it is not hot enough to satisfy the thermostats, an auxiliary gas burner turns on automatically to heat it.

Beyond the easy task of learning to like the storage chambers, the Löfs have not had to make any concessions to their unique heating system. They have all the windows they wanted—a lot, for the house stands on rising ground with a 150-mile-wide view of the Rockies. There are 17 picture windows, 10 others of more normal size. All have double panes—a precaution any homeowner is likely to take in that climate.

The cold-air-return grilles and hot-air registers throughout the Löf house are conventional and unobtrusive.

The furnace room looks normal, but there are two water tanks. A small heat exchanger is connected to the larger (80-gallon) tank. As hot air from the solar collectors is drawn down from the roof, it passes over water-filled coils in this exchanger, heating the domestic hot water, which enters the 80-gallon tank. Water warmed this way then flows on into a smaller (60-gallon) tank, equipped with an automatic gas heater. If the water by now is as hot as the thermostatic control demands, it is distributed to the house just as the sun warmed it. If it is not hot enough when it arrives in the smaller tank, the burner quickly brings it up to the required temperature.

Thus, in sunny weather the gas burners in the furnace and in the smaller water tank are called upon only if the solar-heated air and water need a few additional degrees of temperature. At night, during spells of fair weather, there is almost always solar heat in storage to draw on, even during a cold snap. During cloudy or stormy weather that persists more than a day, the house's standby gas furnace has to shoulder the burden.

It will never be practical to try to heat a house in a cold climate entirely by the sun, Dr. Löf says. To do so would require a solar-heating system so large that it would cost much more than the combination of solar and conventional heat that he is now using. In the Denver setup, the furnace and auxiliary fuel carry a modest fraction of the heating load.

How much does it cost to heat a house by this fuel teamwork? It is far too early to say, Dr. Löf told me. Both he and American Window Glass Co. say they must accumulate a lot more data and much longer experience with their system to make dependable estimates.

This first solar-heating unit cost much more than it would if it were being mass-produced. Ten years from now, Dr. Löf predicts, the price of the solar portion of a typical house's heating system may be trimmed to $1,000.

By the late 1960s, he says, the cost of fuel for heating a house by the method American Window Glass is now pioneering should be only one-fifth as much as the cost of heating by conventional methods in the same locality.

Dr. Löf intends to link an air-conditioning system to his solar-heating unit, using the sun much as gas is used to chill a refrigerator. When that happens, to change over from heating to cooling their house, the Löfs will merely throw a couple of switches.—*Wesley S. Griswold.*

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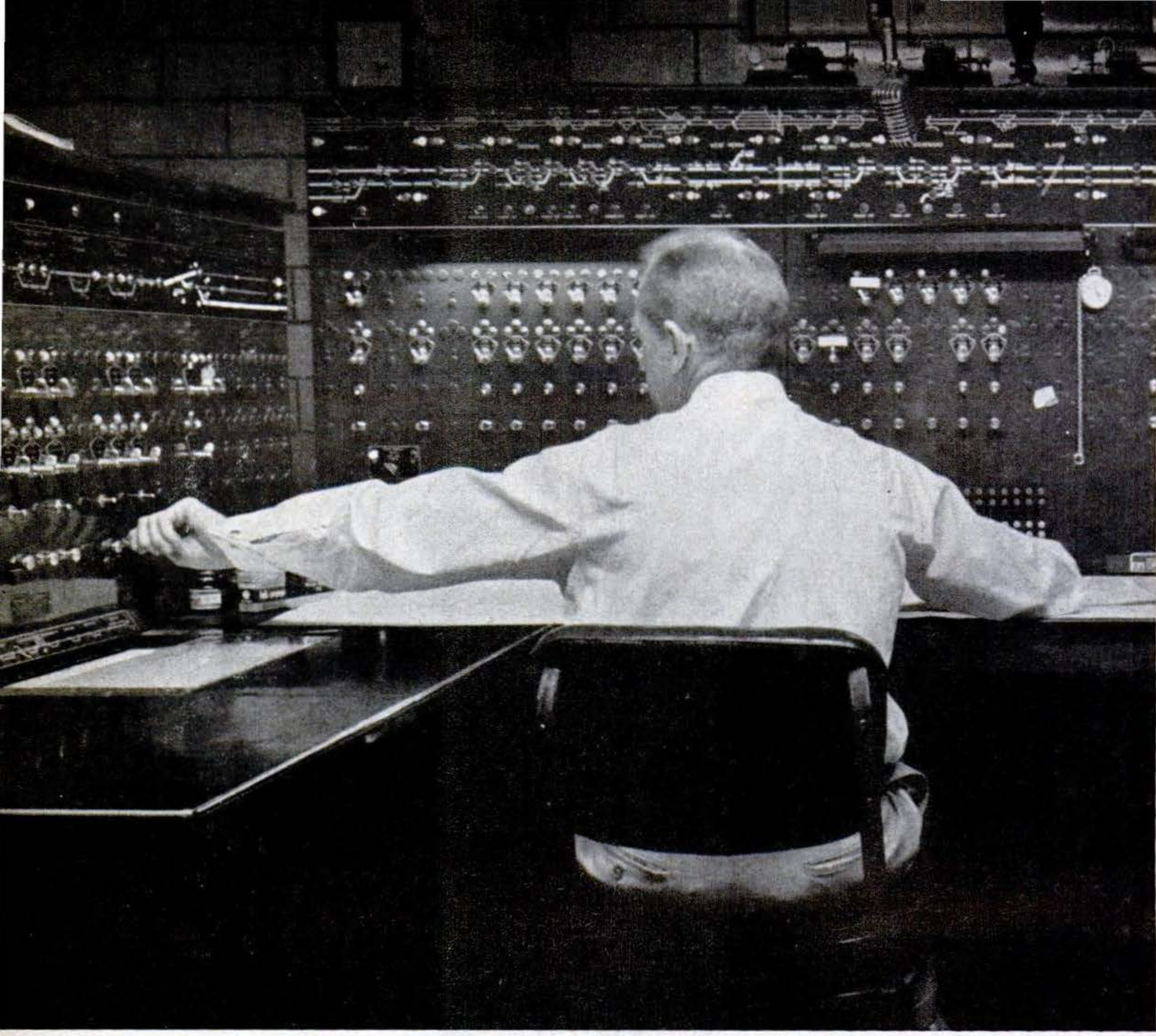

Seated at Centralized Traffic Control board, Milwaukee Road train dispatcher Bill Kelly sets

The Robot That

Milwaukee Road's big brainbox puts 330 miles of high iron under the dispatcher's thumb

By Henry B. Comstock

IN THE little railroad town of Perry, Iowa, a train dispatcher nightly plays one of the world's hottest transportation symphonies. His keyboard is the largest Centralized Traffic Control machine ever designed for one-man operation.

Seated within reach of 269 miniature levers, toggles and buttons, this Milwaukee Road dispatcher can throw a massive track switch located 210 miles to the east, or change the color of a searchlight signal 120 miles to the west. The big machine shows him the location of every train on the high iron between Green Island, on the Mississippi River, and Council Bluffs, on the Missouri. It gives an emphatic *ping* each time one of these trains clears a switch, and flexes a robot hand to jot down the exact time with a fountain pen. It indicates which way the switches are lined up at turnouts, and what signals are being displayed. It brings in the voices of trainmen calling from trackside phones,

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up signals and switches clear across the State of Iowa for 11 world-famous streamliners.

Runs a Railroad

of enginemen riding high in the cabs of streamliners and mile-long freights, even of the walkie-talkie-equipped signal maintainers who ceaselessly tend this fantastic machine.

We watched this CTC machine at Perry put on a late, late show recently with 11 of America's most famous "name" trains. Rain, one degree above sleet, was slashing at the station platform as PS photographer Bob Borst and I made a run for the dispatcher's office. "Nice weather for indoor shots," Bob shouted.

But Milwaukee Road's supervisor of signals and communications, R. R. Mc-

"CITY OF SAN FRANCISCO" takes on water just outside the dispatcher's office in Perry.

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"It's kind of like a piano with its keys so interlocked you couldn't possibly strike a sour chord with them"

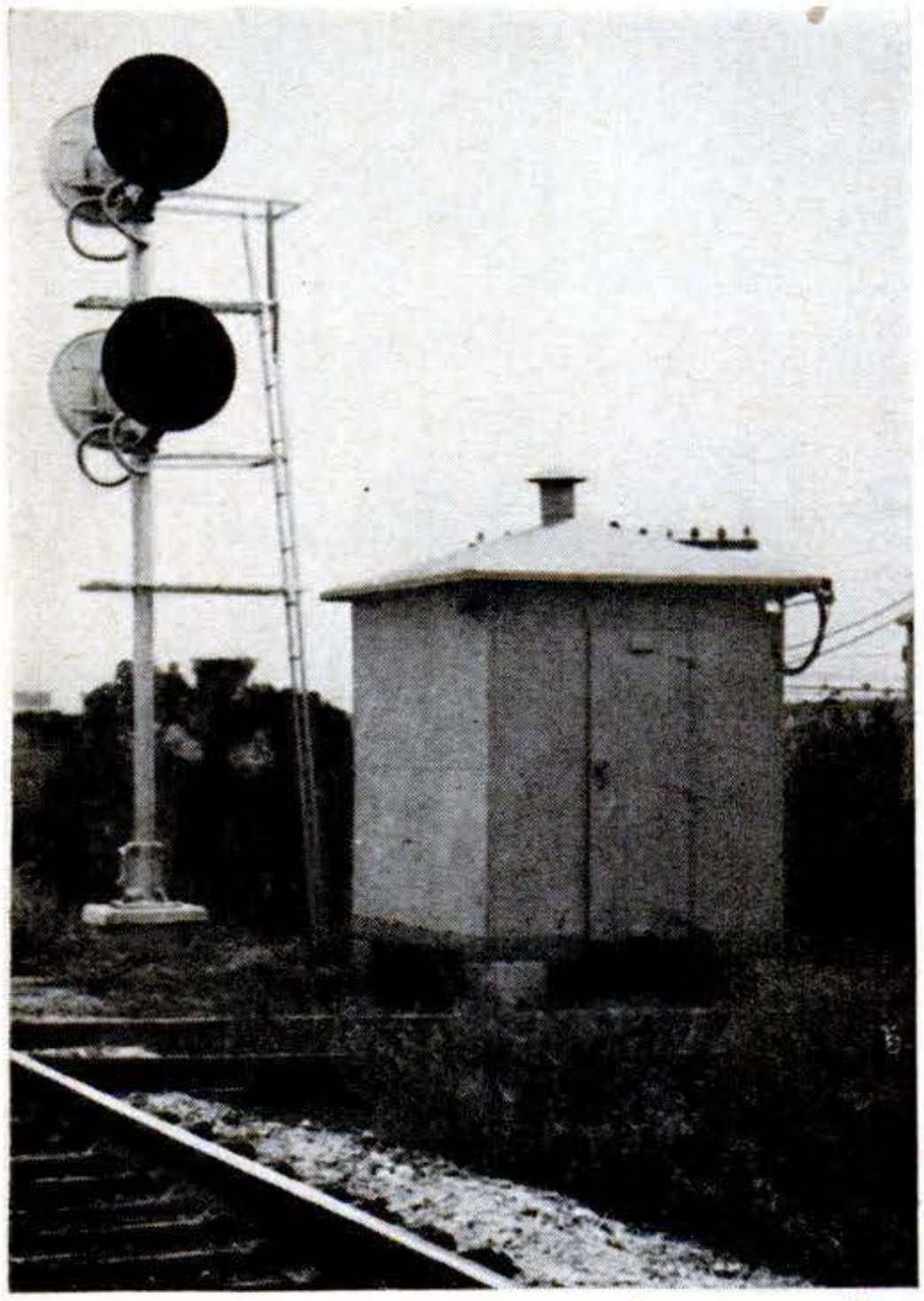
Conahay, had other ideas. As soon as he had helped us stow our cameras and tape recorder in the chief dispatcher's office he tossed us a couple of slickers.

"Before you have a look at the board," he said, "I want to drive you out to Herndon, 12 miles west of here, to see how close a dispatcher times his meets with CTC."

As we sizzled along the dark highway, McConahay filled us in on the Iowa Division setup.

"Time was," he said, "when we had double track most of the way across the state. Now we're handling more traffic than ever with only one. CTC does the trick by giving a dispatcher a moment-to-moment picture of what's happening out on the road, and making him his own switch tender. That way he can put trains around each other on sidings with split-second efficiency and a minimum of track.

"Pulling up one set of rails pays off three other ways—reduced operating costs, less track maintenance, and a nice cut in taxes because, once we remove a track, the roadway beneath it reverts to unimproved property. Add them all up and this is a good investment, even though it cost the Milwaukee around $14,000 a mile."



"FIELD LOCATIONS" like this shed receive orders transmitted by the CTC machine and convert them into the electronic muscles that throw track switches and change signal indications.

McConahay turned off the main drag and headed west along the shoulder of the right-of-way. Two hundred yards ahead, a searchlight signal tossed two spears of red light over our heads and on toward Perry.

"Shows what the right reflectors and lenses can do for a couple of eight-volt bulbs," McConahay said as he stopped the car. "That board is set against Number 111—the 'City of Denver.' Beyond the signal, the two tracks beside us narrow down to one. You'll notice the signal across the way is showing red-over-green. That's for Number 20, our eastbound 'Arrow.' Red-over-green means the dispatcher is going to put her on Number 2 track. If the board showed green-over-red, the switch would be lined for Number 1."

"You mean trains don't always hold to the right at turnouts?"

"Not with CTC. We run 'em whichever way suits us best. At Perry, for example, we put both east- and westbound passenger trains on Number 2 track whenever we can, because it's nearest the station."

"Could a dispatcher set up the switches for a head-on collision?"

McConahay shook his head. "He could try, but the CTC machine wouldn't let him. It's kind of like a piano with its keys so interlocked you couldn't possibly strike a sour chord with them."

He pulled out his watch and turned its bold numerals to the map light under the dash. "10:13. Number 20 should be showing in about two minutes. She's due here at 10:20."

He was off by 10 seconds. At 10:14:50 Bob pointed to the west and said, "Here comes Sputnik!"

A wobbly little blur of light had just tipped the horizon. It was a good three minutes before it broke in two and became a pair of locomotive headlights—the top one steady, the one below it painting the rain with violent cross-strokes.

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RAIL-RIDING PONTIAC used by division superintendent Jim Hayes is too light to operate block signals. Dispatchers protect it with signals controlled from the CTC machine.

"Best crossing warning ever invented," McConahay said. "When we first started using those oscillating beams, folks slammed their cars in reverse and dug out fast. They figured our trains had jumped the tracks. Now, look behind you."

Away off to the east was another little Sputnik.

The CTC machine had done a nice job of orbiting. The "Arrow" crashed by us right on the advertised, a blur of barred mail-car windows, followed by the flicker of dimly lighted coaches and sleepers. A moment later the upper signal on the mast beside us winked from red to green.

"Dispatcher's just given the 'City of Denver' the single track," McConahay explained. "A light on his panel told him the instant Number 20 cleared the switch."

The "City" train was in a hurry. She bore down on us with her airhorn braying hoarsely for the crossing. At 10:23 she was only a puddle of rear-end lights and the wave of a flagman's lantern.

"Guess we could do with a cup of hot coffee about now," McConahay said. "But there's one thing more you should see before we head back to Perry."

He wheeled the car around, returned to the crossing, then doubled down the other side of the right-of-way to the signal facing west. A few yards distant was a welded sheet-metal shed, with a phone box on a pole beside it. We climbed out of the car. McConahay unlocked the shed door with his switch key and snapped on the lights. Inside, the air was filled with the hum of trickle chargers keeping the soup up in a bank of wet-cell batteries. Above them, shelves loaded with relays lined the walls.

"We call this a 'controlled field location.'" McConahay said. "There are 60 others like it strung along the Iowa Division. In effect, they're the robot switchmen and telegraph operators of our CTC setup. When the master machine in Perry says, 'I want to throw the switch for Number 2 track at Herndon,' the order goes over our carrier wires in the form of a 16-unit signal—a combination of dots and dashes that every other field location on the line ignores. But three little relays in that glass-windowed box to your left give themselves a sudden nudge. 'Hey, boys,' they say, 'that's us!'

"So they snap closed, and this passes the word along to a succession of other interested relays. Between them, they close the circuit, and a 24-volt battery pours a shot of DC juice into the switch motor. It takes that motor exactly 14 seconds to move three tons of steel from one

[Continued on page 250]

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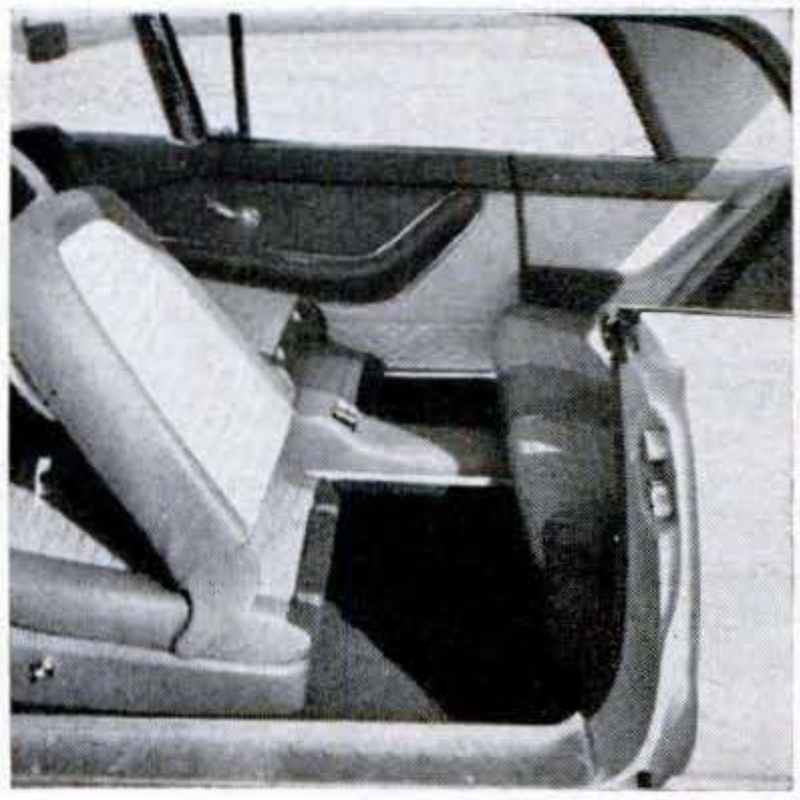
T-Bird Now Totes Four

Longer but low as ever, it has plenty of headroom, adequate luggage space—and more than family resemblance to the Continental's well-bred beauty

By Devon Francis

LAST month the Ford Motor Co. did something that is going to outrage a lot of people. It junked its two-seater Thunderbird. At the same time, it did something that is going to delight a lot more people. It brought out a four-seater Thunderbird.

The new T-bird is a hardtop. It's longer, heavier and a lot roomier than its predecessor. It's powerfuller. It's built differently. In appearance, it's a sort of vest-pocket Continental Mark II. Fine so far—



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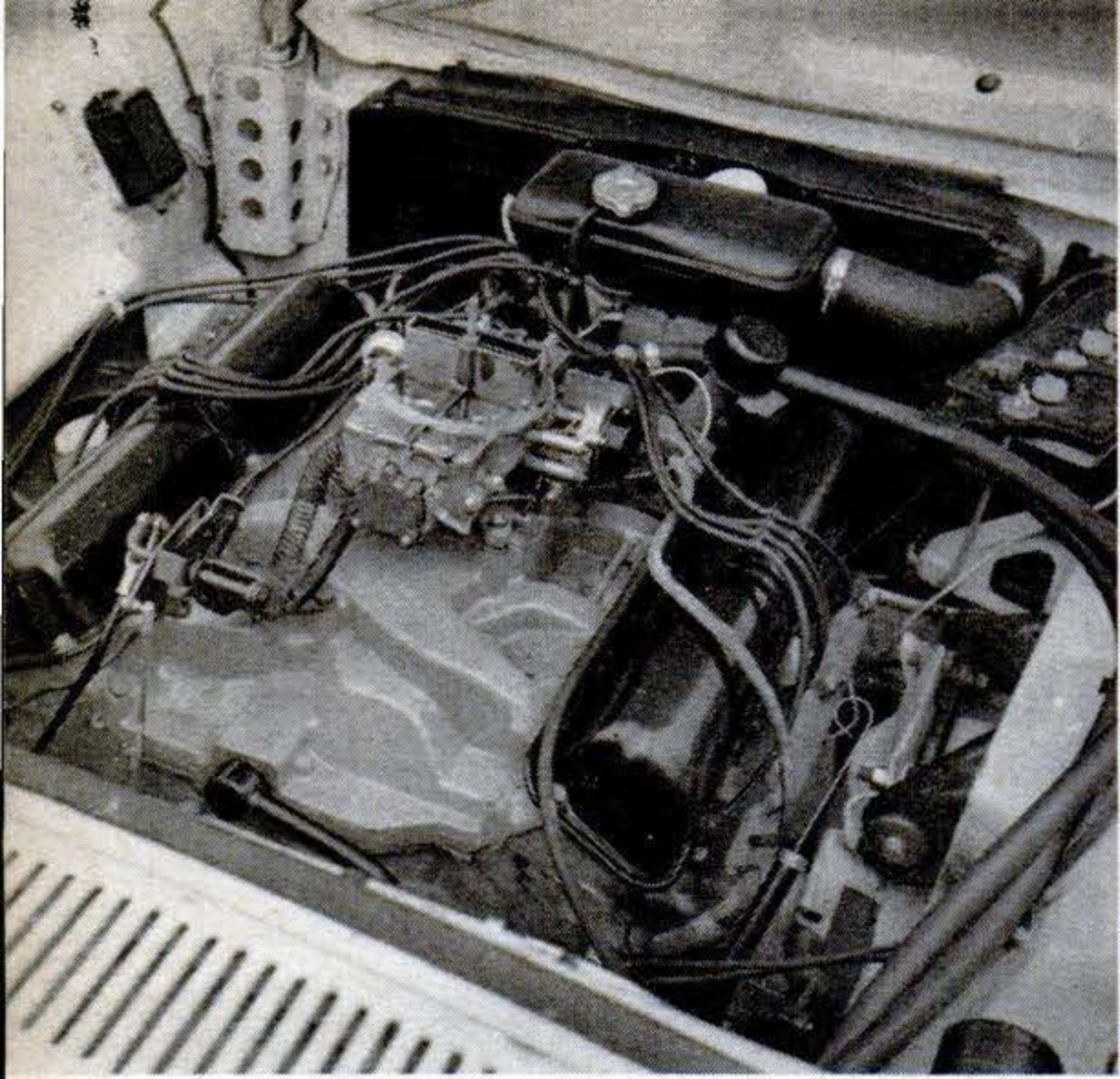
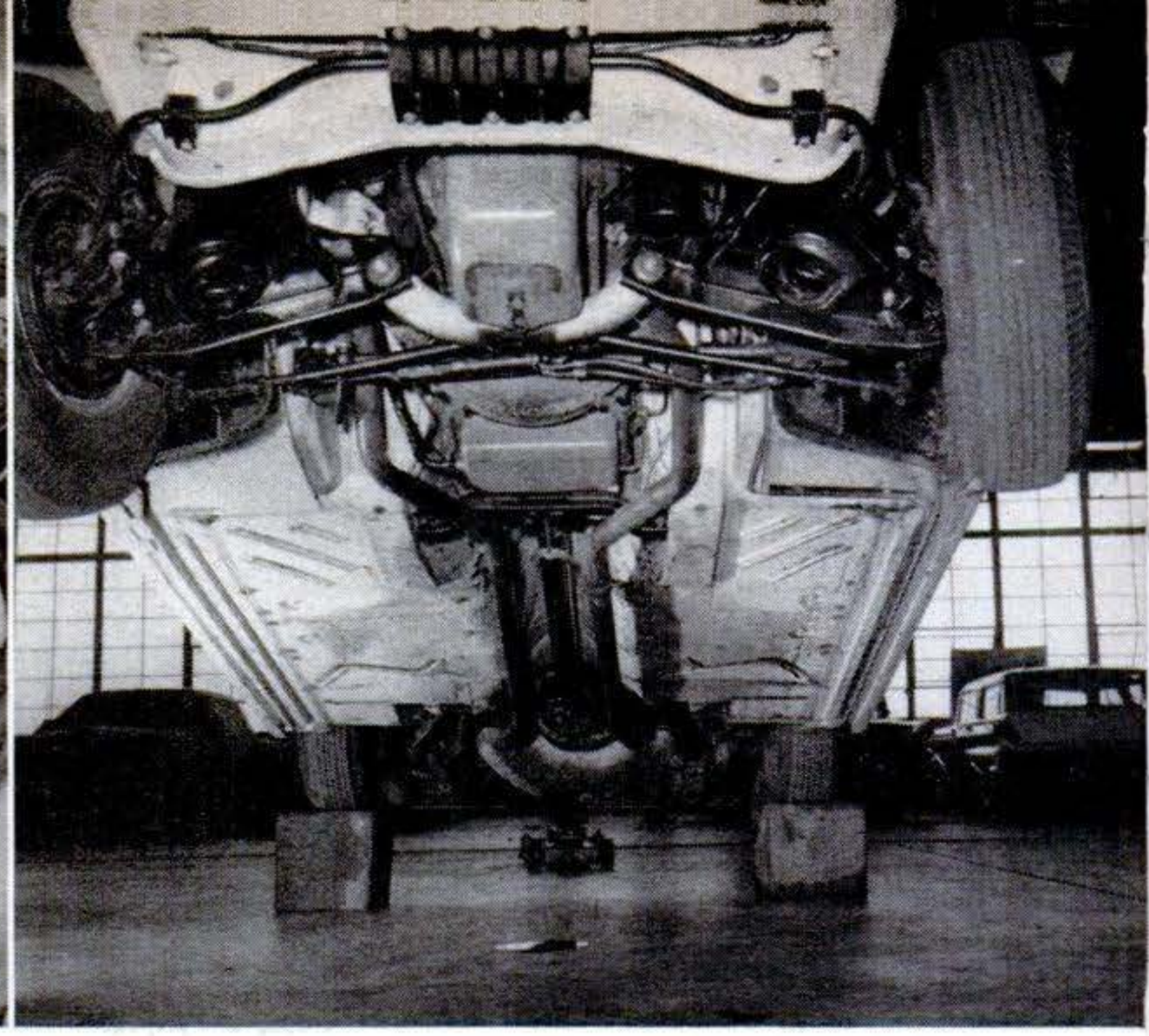


ENGINE OF 300 HORSES gives Thunderbird a weight-power ratio of 12.8 pounds-to-one. T-bird's 3,848 pounds may be trimmed.



UNITIZED BODY—like those used by Lincoln and American Motors—lowers floor, makes room for exhaust pipes in transmission tunnel.

but that isn't the real story of the new Bird. I'll tell you some things that even Ford insiders aren't saying out loud. But first, the vital statistics.

Overall length is 205.4 inches. That's about 3½ inches longer than a 1958 Ford Custom 300. Wheelbase is 113 inches. That's up from the two-seater's 102, but is several inches shorter than the wheelbase of a Chevy, Ford or Plymouth.

Width is 77 inches. That's an inch shy of the Ford's. Height is 52.5 inches—practically that of the old hardtop two-seater—but 4½ inches lower than a Ford Custom 300 or a standard Chevy. It's four inches lower than a standard Plymouth.

Yet the Bird's passenger headroom, front and back, comes—astonishingly—to within a fat inch of that in the Plymouth, roomiest of the Big Three. Nor is the ground clearance sacrificed. It's more than six inches. That compares with less than six in the Ford, 6.8 in the Chevy and 5.4 in the Plymouth.

Power? Each of the T-bird's horses has to tote 12.8 pounds of car.

For comparison: the heftiest Chevy, 12.3; Ford, 11.9; Plymouth, 11.1; Caddy Special, 16.4; Lincoln Premiere, 13.1.

This implies that the new T-bird is a pretty heavy car. It is. With that 300-horse engine, it weighs 3,848 pounds (compared with 3,622 for a Fairlane 500 two-door hardtop) standing empty at the curb. That's too much, and the Ford people plan to do something about it. Well, there you are.

How did all this come about? To get at the whys and wherefores, you have to understand the way Ford tycoons work. With most other Detroit manufacturers, a car is designed and styled, and then (inevitably) the top brass begin talking it over at home. Presently a reigning vice president will come bustling into his office on a Monday morning and announce, "The seats have got to be an inch higher." That's not him talking, it's his frau. The seats *are* made an inch higher, too.

Nothing like that happens at Ford Motor. They do everything by market surveys. If a market survey should show that U. S. motorists want raccoon tails on their radio antennas, you can bet your bottom dollar that Ford would put a raccoon tail on every radio antenna. It's the way they think.

The first T-birds were marketed in the fall of 1954. By early spring, 1955, Ford had begun a market survey of the product. What did owners like about it? What *didn't* they like? Ford wasn't satisfied with the results of its own survey. It hired some outside people to do a survey of its survey. Before the frost was on the pumpkin, Ford had its answers:

T-bird owners were utterly batty about their cars, but they wanted:

1. More entrance room.
2. More luggage room.
3. Room for more passengers.

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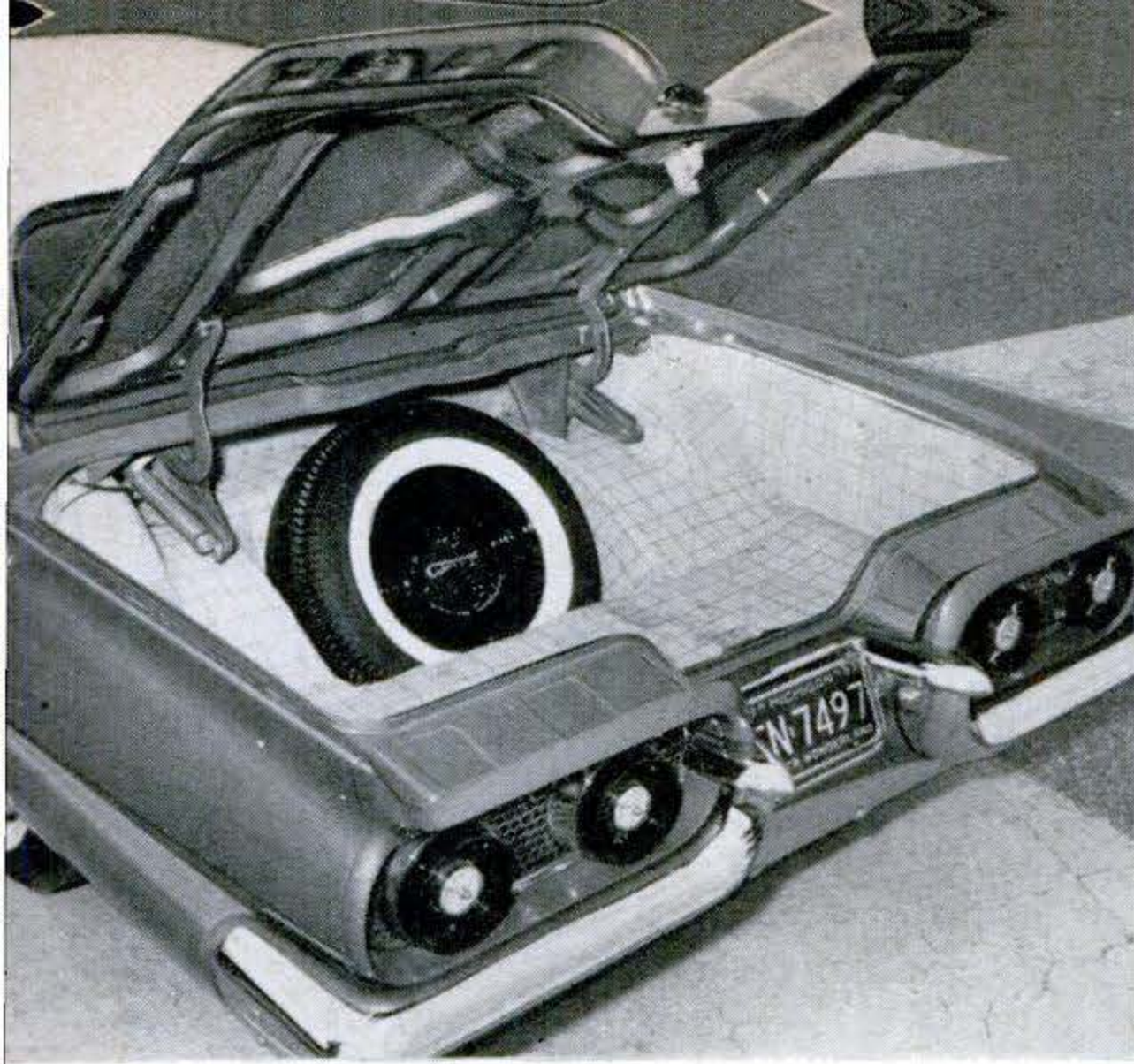

LUGGAGE COMPARTMENT, with centered spare, offers utilitarian hauling room—22 cubic feet worth (Ford Custom 300 has 28.9 cubic feet).

BETWEEN-SEATS CONSOLE atop the transmission hump contains heater controls, ash tray, radio speaker, switches for electric windows.

The Ford brass said to its stylists, "If you had $100,000 to spend on a custom body, show us what you'd build." It said to its engineers, "Dream us up a four-passenger Bird." It said to the stylists, "And, oh yes, don't destroy the looks of the Bird." It said to the engineers, "And, oh yes, while you're at it, make the body and frame in one piece, and put in coil springs because we'll use air springs maybe, and be sure to leave room for air-conditioning."

So they did.

When the original two-seater Bird was introduced, Ford hadn't known how to characterize it. Lewis Crusoe, division general manager at the time, christened it a "personal car." The Bird wasn't designed as a sports car, and it wasn't one.

Nor, by any stretch of the imagination, is the new Bird. But the Ford people know what to call it now—and thereby hangs the story that I promised you. The car is simply a four-passenger, two-door pillarless sedan that was designed to be 52.5 inches high.

Nothing like it, in a production car, is made in this country. The "sports-type" cars styled by Chevy, Pontiac, Studebaker-Packard, Chrysler, Plymouth, Dodge and De Soto bear no resemblance to it. Chrysler toyed with the idea in its French-designed experimental Facel Vega three years ago. Cadillac had something related to it in its display LaSalle at the GM Motorama in 1955.

These cars and the new T-bird are not only a departure from current sedan design—in some respects they represent a reversal of it. For years, most cars have become ever-bigger, ever-bulgier, ever-gaudier. The Bird packages four persons, no more. It's sleek. Its ornamentation is almost severe. Boasted a Ford spokesman: "We put the styling in the contour of the metal itself, not in the trim." Only the horsepower bulges, and perhaps someone at Ford will be smart enough to reduce that to a palatable and economical size.

Production of the four-seater has not been without its problems. The huge hood, eight inches wider than a standard Ford's to accommodate that engine, tended to flutter at high speeds and had to be beefed up. The car was "over-designed," and considerable weight must still be scalpeled out of it. The big engine imposes so much weight on the front wheels that steering without a power assist is a sweaty wrestle.

But the new Thunderbird remains, like the Mark II that it somewhat resembles, a stylist's dream in elegant simplicity.

It's not likely that production facilities will permit many more than 25,000 T-birds to be turned out in 1958.

But when at day's end the men in charge of the Thunderbird project climb aboard their low-slung chariots in the executive garage, homeward-bound, it doesn't take a telepathist to read their minds: "In passenger cars, here's the shape of things to come." END

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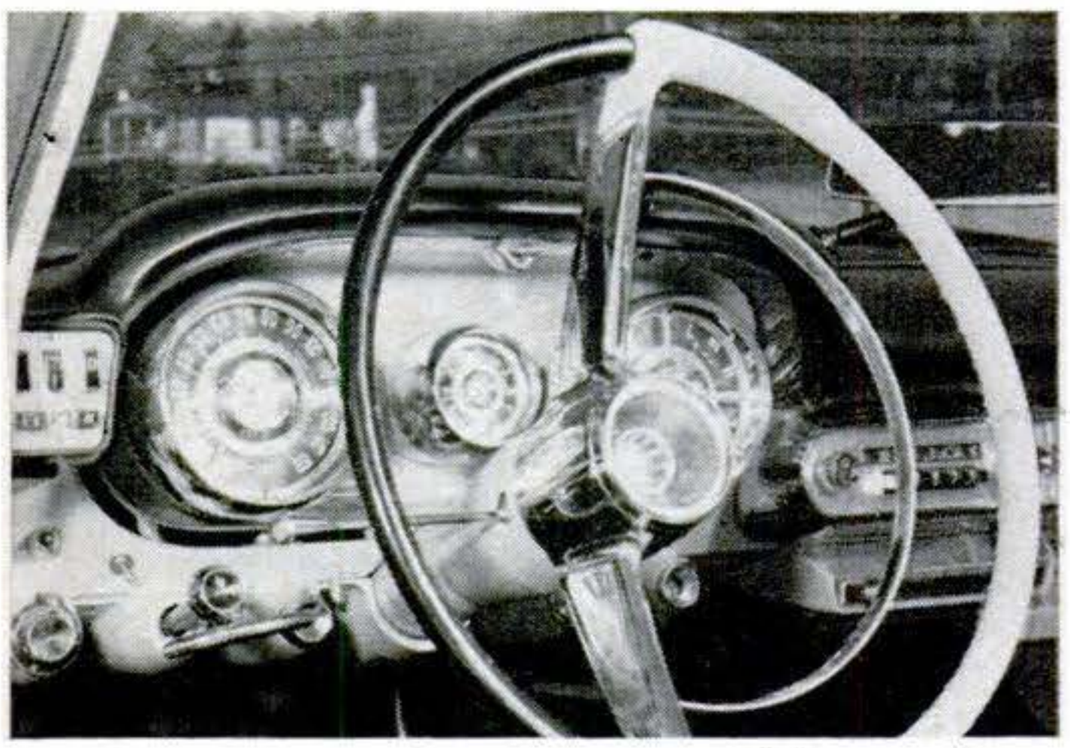
New 300 is built on its own chassis, with basic Windsor body and special grille. Power: up.

Chrysler 300D Has Built-In Roar



SPEEDOMETER registers up to 150 m.p.h.—which is little exaggeration of potential. On straightaway, car has hit up to 144 m.p.h.

DOUBLE-WRAP WINDSHIELD is most obvious change for 1958. From start, the car has been notable for sparse use of chrome ornamentation.

THAT department in the Chrysler Corp. known awesomely as "Central Engineering" was startled and puzzled a few months ago when it was asked to design a carburetor air cleaner without an air silencer. This simply wasn't done. *Everybody* used air silencers. How come no silencer? asked Central Engineering.

The answer emerges with the introduction of the Chrysler 300D, fourth annual version of the corporation's "bomb."

Bob Rodgers, Chrysler Division's chief engineer and originator of the "300" idea, wanted his customers to hear as well as feel the car's power. The result is music. At hard throttle, the in-going air is a baby tornado, yet at cruise only a whisper. To bracket his power package with sound, Rodgers removed some of the muffler baffles. Result: an authoritative mutter at the tailpipe.

At $5,108 factory retail, including federal excise tax and dealer handling (compared with $4,759 for a two-door hardtop Imperial), the "300" is up five notches in horsepower from 375 to 380. That's with carburetors. Add 10 more for the Bendix fuel injection (PS, Mar. '57).

Like any "personalized" car, the "300" has become a product of its owners' desires. When it was first introduced, Chrysler assumed that it would be bought by men in berets and sports jackets. But perfectly conservative businessmen bought it to drive something a little different.

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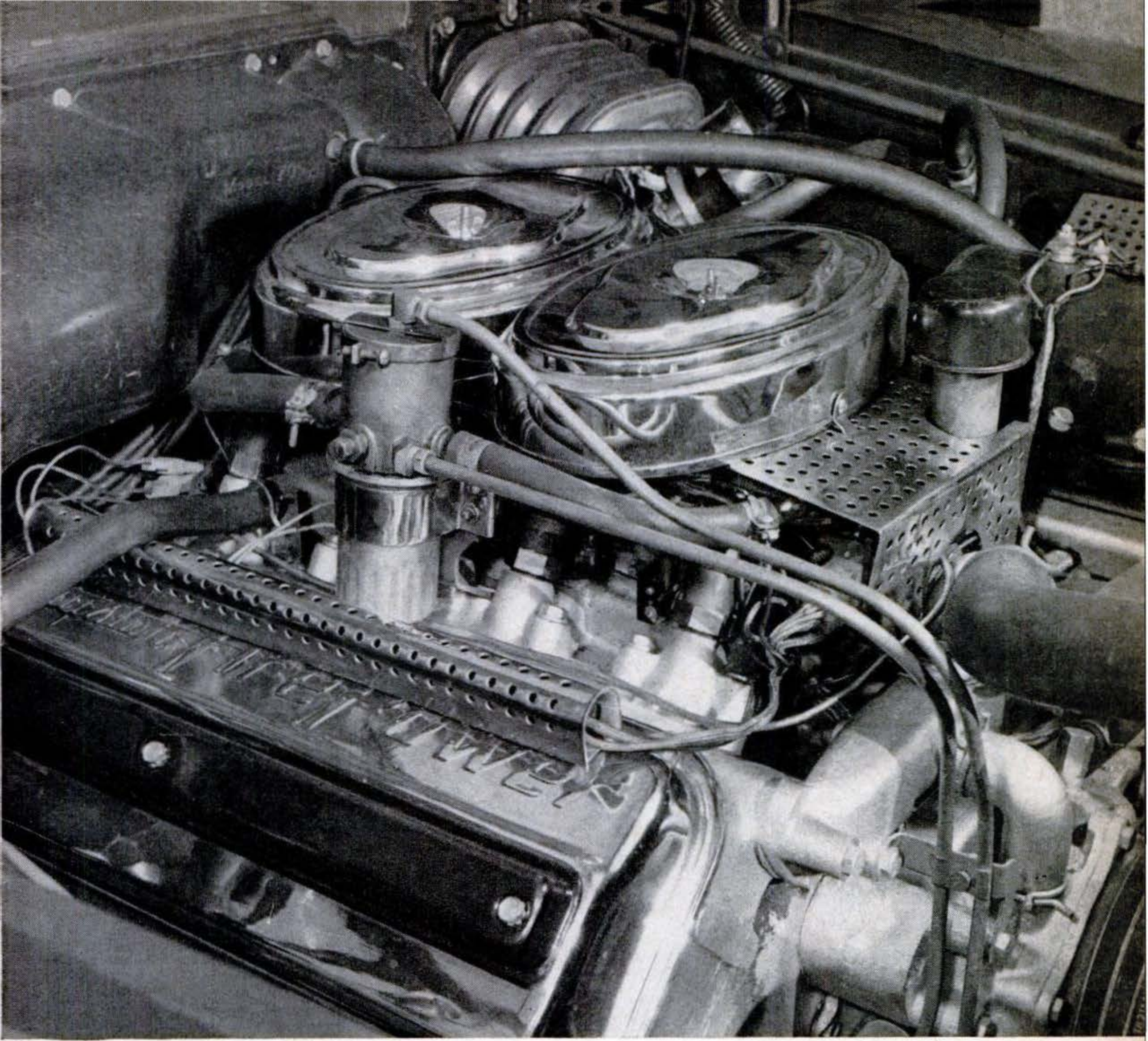

New electronic fuel-injection system boosts power, gives performance without long warmup.

They wanted such things as air conditioning, limited-slip differentials and automatic boxes. And they got them.

Like its predecessors, the 300D is a bit rough at idle. That's due to exhaust-gas dilution of the incoming gas-air charge at low engine speeds, and *that's* caused by a cam designed for high-speed performance. The ports stay open longer but snap open and shut faster than those in the Imperial or New Yorker. Valve trains are wholly mechanical. That permits engine speeds up to 5,200 r.p.m.—some 400 more than hydraulic lash-compensators, with their tendency to "float" valves, will supply.

Chrysler says the "300" is the fastest and most exclusive U. S. production sedan, and can affidavit both. In 1955 and 1956, the "300" was the National Association for Sports Car Auto Racing (NASCAR) grand national champion. In 1955, it was named the American Automobile Association's champion stock car. In 1957 it did not compete officially, but at NASCAR's annual speed carnival in Daytona Beach it turned in the fastest flying mile for stock cars (135 m.p.h.) and the fastest average speed for a mile from a standing start (86.8).

Less than 5,000 of the cars had been sold when the third year's production was closed out in 1957 and manufacture of the "D" series started. If 1,800 are sold in 1958, it will beat any of the previous years.—*Devon Francis.*

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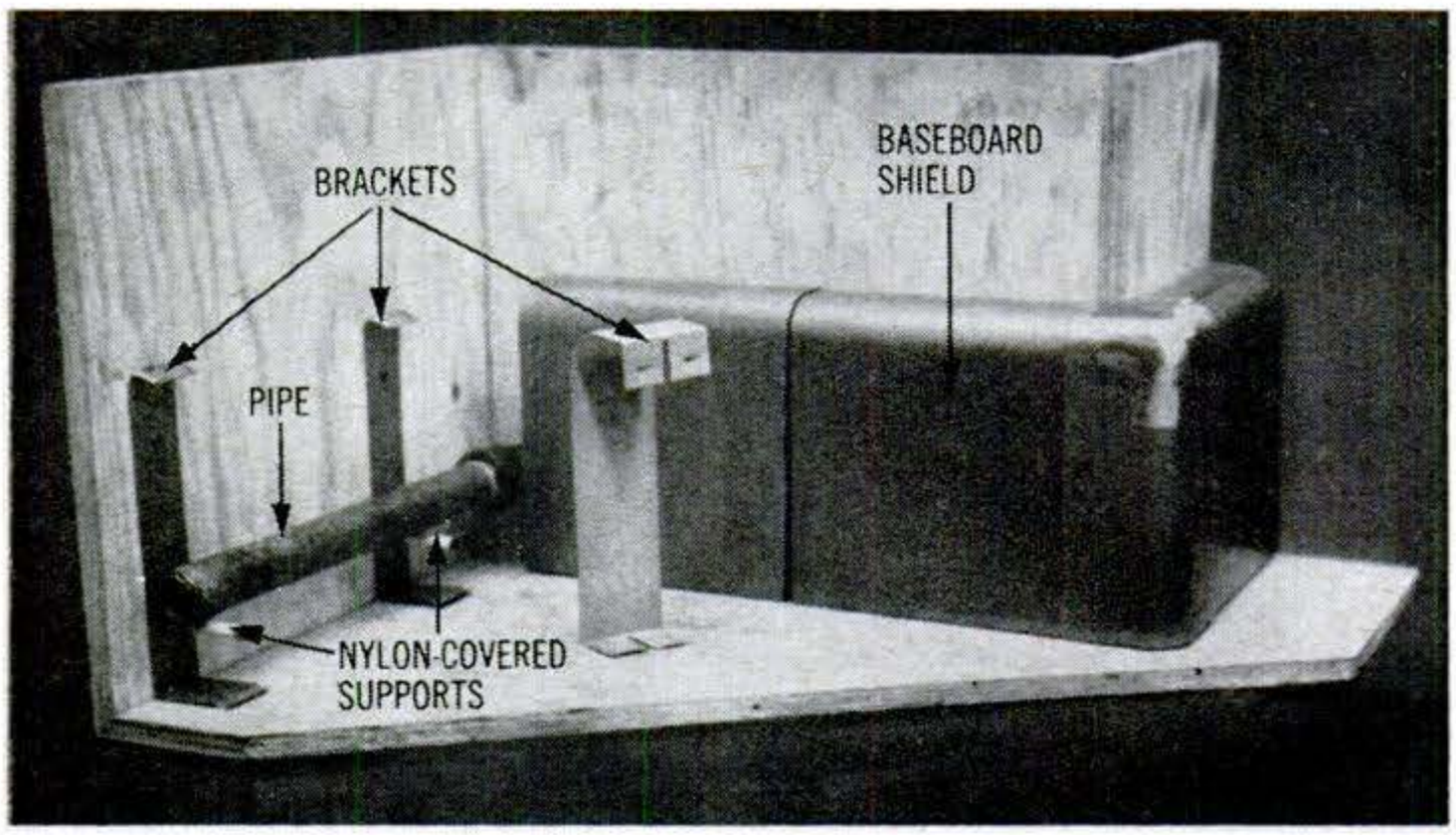
From the labs...

Hot-Water Heat



"Radiant ribbon" is just a pipe

PLAIN PIPE—¾-inch black steel—takes the place of expensive radiators or baseboard convectors in new home-heating plant now being tested. Pipe is installed at baseboard level on supports that also grip a sheet-metal cover. Hot water in the pipe radiates heat to the cover, which then re-radiates it to warm the room.

A RADICAL new development promises to put the hot-water furnace —long a favorite for its even comfort—back into thousands of U. S. homes. It should cut hot-water installation costs in half, and give forced-warm-air heating, now the choice of three out of four homebuilders, a run for its money.

The new system is remarkably simple, and completely eliminates both radiators and conventional baseboard convectors. Instead, the hot water is pumped through a simple loop of plain ¾-inch black steel pipe running around the house.

First tests indicate that the whole system—pipe loop, boiler and controls—can be put in a five- or six-room one-story house for about $400 to $450. Two men do the job in eight hours or less. (This is for new construction; it will of course take longer in an existing house.) Total first cost for conventional hot-water heat today, for a comparable house, runs from $800 to $900. Most of the savings with the new system come from the reduced materials cost and labor of putting heat-distributing equipment in each room.

Why hot water? Mainly, because many people prefer it. The postwar swing to warm-air heating was largely the result of its sharply lower first cost. Before World War II, hot-water systems held half the market. Either type, if soundly designed and correctly installed, gives approximately equal comfort and operating economy.

The new system is called "radiant ribbon." It can be used in new or old houses, or in a new addition to an old house (provided you already have hot-water heat). It is an industry-wide development, but is still experimental.

How it works. The change is in the method of distributing heat to rooms. You still use a regular hot-water heating boiler (any make), circulating pump and controls. The pipe loop goes at baseboard level along the outside walls. A thin sheet-metal cover about six inches high covers it.

In operation, water up to 240 degrees is pumped through the pipe loop, and heat is radiated from pipe to shield to room. The loop is a closed circuit with the water under slight pressure so it will not steam. In the few tests made so far, the new system has performed very well.

On a four-below-zero day in a Chicago test house, for example, the crucial temperature spread between floor and ceiling was three degrees—72 at the ceiling, 69 at the floor. That's pretty good. You don't begin to feel cold until the floor is more than about five degrees cooler than the ceiling.

Why it works so well. Although researchers are still not absolutely sure,

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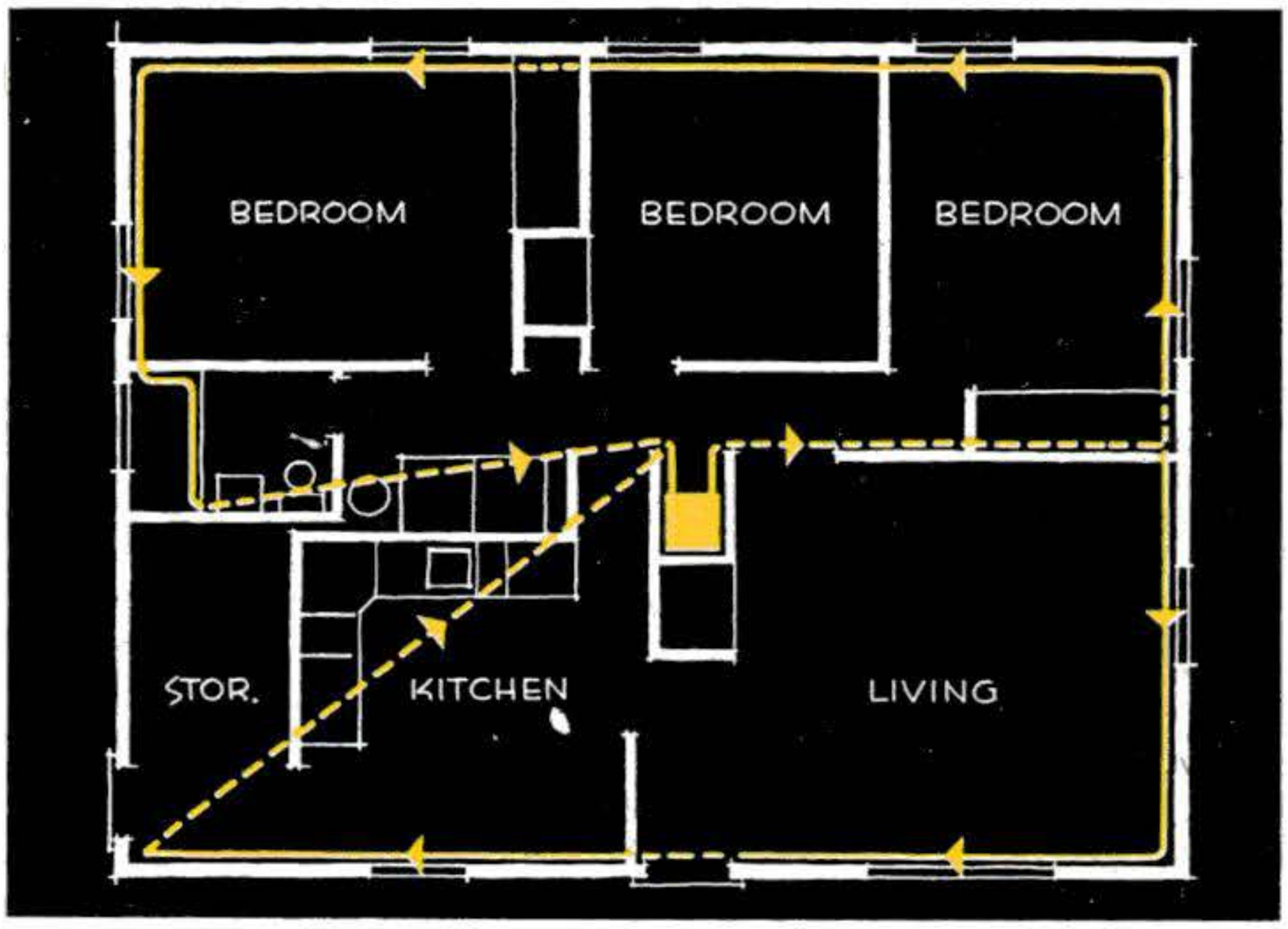
Without Radiators

Simple system may halve cost

LOOP OF PIPE around outside walls comfortably heats small one-story houses, trials indicate. Standard boiler supplies 240° water through feeder lines under floor (dash lines). Floor plan at right shows actual setup in full-scale test model of a prefabricated home. Installation of entire heating plant becomes a one-day job for two men.



two main reasons are offered by radiant ribbon's inventor, soft-spoken Edwin Tidd, one-time steam fitter who is now chief of field research for Bell & Gossett, the heating-control firm.

First, Tidd explains, most of the heat it supplies to a room is radiant heat, the best for comfort. Most current hot-water heat operates by convection—room air passing over the heating element is warmed and passes on and up, carrying the heat it has absorbed. Radiant heat, like warmth from the sun, is more direct and satisfying.

Second, the baseboard pipe strikes directly at the two main sources of cold and drafts: the exterior walls and the floor. Heat from the pipe warms up the walls behind it and the floor below it. There is no heat loss from your body to these normally cool surfaces, thus no drafts, chills or goose pimples.

Drawbacks. Before the new system can be approved for houses, a thorny rating problem must be licked. Tidd explains that according to present-day engineering tables, black steel pipe, though the best radiator among pipes, is just not rated high enough for house heating. With 240-degree water, for example, the tables say that ¾-inch black steel will radiate only 131 heating units an hour per foot of pipe. According to the book, you need at least 200 to 300 units for adequate heating.

In practice, however, the system evidently does this or better. Either the tables are too conservative or some unknown factor is at work.

Any other limitations? Apparently no serious ones. Engineers check off these points:

- Safety? The metal shield over the pipe does get as hot as 160 degrees, but standard radiators often run hotter.
- Operating costs? Tests are still incomplete, but indicate that fuel expense will be no more than that of conventional systems, perhaps less.
- How about poorly insulated houses? One solution: Combine the pipe loop with a few conventional finned units, installed where you need a concentrated dose of heat.

The system sounds so simple that skeptics still do not believe it works. It not only does work, but there are now about 20 test installations operating in houses around the country. Two are in National Homes Corp. test houses at Lafayette, Ind. NHC, biggest U. S. prefab house manufacturer, hopes to use radiant ribbon in its future houses. But it may be a year or more before all test data are gathered and analyzed, and the system is officially put on the market.—*A. M. Watkins.*

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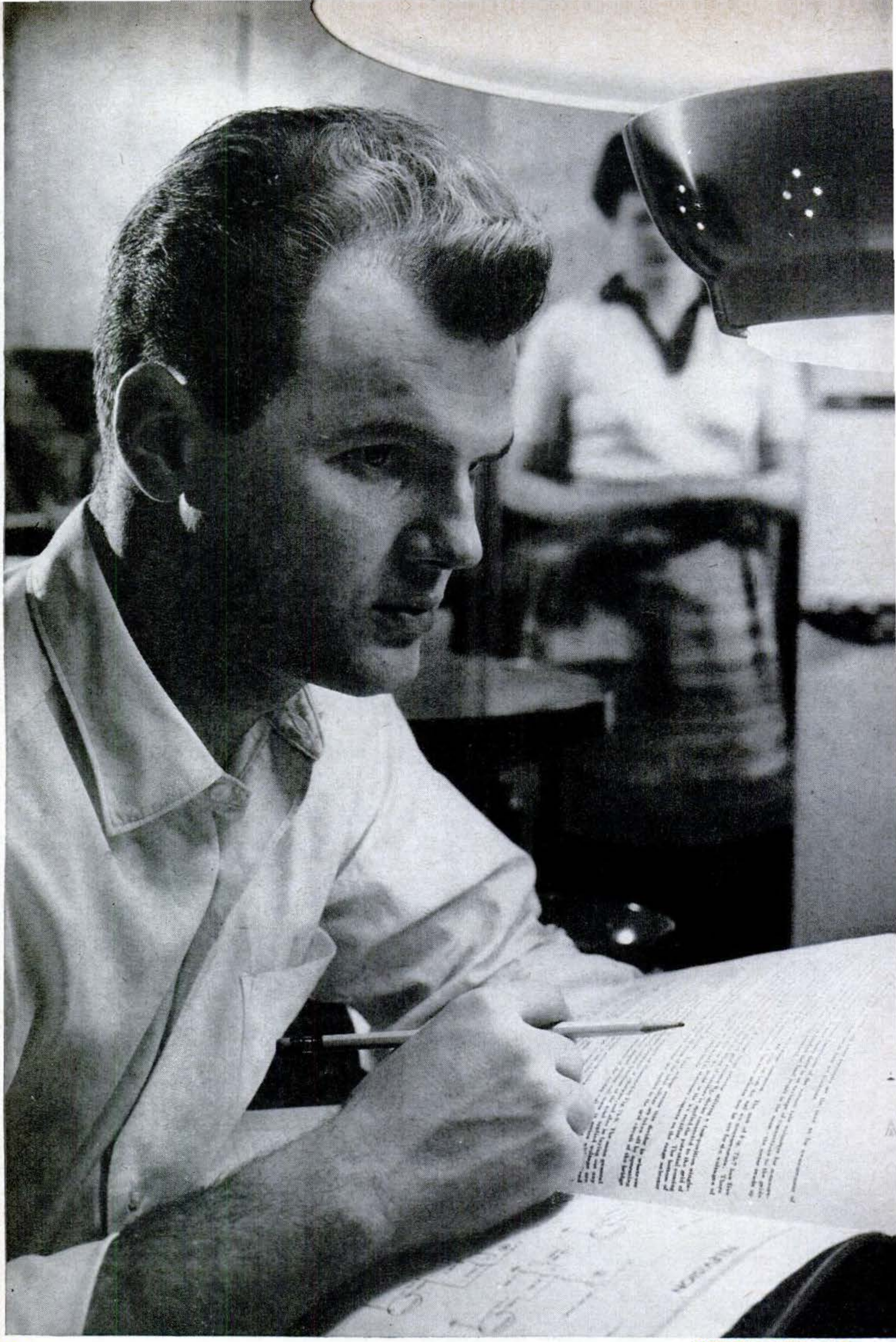

PHOTO BY ROBERT D. BORST

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Plain Facts About Correspondence Schools

By Martin Mann

Studying at home to get ahead is a grand old American tradition. Will it work for you? Here's what you should know before you mail the coupon for a course

Part 1: What Are They Like?

JUST reading the newspapers, post-Sputnik, you can spot the big opportunities coming up. As America's all-out effort to beat the Russians gets into high gear, there will be promotions and new jobs in all fields of science and engineering, in drafting, electronics and aviation, in the building, machinework and chemical trades. They'll go to men with specialized training.

You'll want to cash in on these opportunities. But most likely you have a family to feed. You can't quit your job to get additional training. Then how about correspondence schools? Can you get ahead by studying at home?

Last year 1,200,000 people were doing it. They were upgrading their skills or learning new trades from schools they never visited and teachers they never saw. The big majority of them were like the big majority of POPULAR SCIENCE readers: young married men working at jobs that go with higher-than-average skills.

How does it work out? Should you, too, try a study-at-home course? It's a serious decision to make: a chance for success on the one hand, the expenditure of real money and a lot of spare time on the other hand.

POPULAR SCIENCE took a hard look at correspondence schools for you. We mailed in the coupons you would be asked to mail. We visited some schools. We interviewed businessmen and educators. What we found is revealing.

Study by mail is a big, complex and fascinating business, deeply rooted in the American get-ahead tradition. Both International Correspondence Schools and the University of Chicago Extension School started in 1891, the American School in 1897. La Salle Extension University this year celebrates its 50th anniversary.

Which kind of correspondence school? If you take the name to cover every institution that dispenses education through the U. S. mails, there are three main groups. It pays to know how they differ —and why.

- Private correspondence schools—such as ICS, National Radio, Commercial Trades—are set up specifically to sell educational services by mail.
- University-extension correspondence schools are operated by about 150 regular

NEXT MONTH, Part II: What Can They Do for You?

The correspondence schools' promise is plain: advancement in your job—or a better, higher-paying job. Do they deliver? For the answer, Popular Science asked thousands of ex-students: Did your mail-order study help you get ahead? You'll find the results of this firsthand report in PS for March.

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colleges, mostly as divisions of state universities.

- Organizational schools are run by the armed services (PS, Jan.), large corporations, trade associations and churches. (Courses in religion, incidentally, are also offered by the private correspondence schools.)

One group of study-at-home organizations—guided-reading institutes such as Alexander Hamilton Institute—differs from the others in an important way. They provide books and instructional material, but no examinations. The student does *not* send his work back for grading, but as he goes along in the course he can ask for consultation and assistance.

All three groups have their uses. It's particularly the university and private correspondence schools, though, that cater to your ambition to invest off-the-job time in getting ahead *at* your job. Their courses are much alike.

The universities, naturally, lean heavily on standard college fare. Languages are by far their most popular courses, but the list of offerings covers all fields.

We will concentrate on the private schools because they offer the university subjects and many, many more. Most popular are the upper-level skilled trades—radio-TV, air conditioning, drafting and the like.

The private schools are also the biggest; they appeal to more career-minded men than any other group. Excluding those in the armed services' program, the vast majority of correspondence students—better than 80 percent—are enrolled in the private schools. How do they operate? Here's what happens after you send in that coupon.

Signing up. Your coupon inquiry will bring back by mail a sample lesson and some inspirational literature. It's designed (a) to find out roughly what kind of person you are, and (b) to convince you that you should sign up for a course.

Will a salesman call on you? Could be. Fewer than a fifth of the schools send out salesmen—but these include some of the largest schools: specifically, the oldest, biggest and best known, ICS.

The better schools now choose a salesman—he's called a field representative or, simply, a rep—to be like the ideal life-insurance salesman. They look for a stable, respected member of your community, a friendly source of expert counsel. His commissions depend on keeping you studying, so he's not much interested in selling you a course you'll drop. In some cases, he is specially trained to serve as a guidance counselor.

The rep will telephone your wife to set a time when he can talk to you both. Her cooperation is essential because you will be studying at times when otherwise you might help her with the kids or take her to the movies.

Enrollment. Whether the approach comes in person or by mail, the schools try to guide you into a course that

Lesson Questions

Be sure to number your Answer Sheet 3B.

Place your Student Number on *every* Answer Sheet.

Most students want to know their grade as soon as possible, so they mail their set of answers immediately. Others, knowing they will finish the next lesson within a few days, send in two sets of answers at a time. Either practice is acceptable to us. However, don't hold your answers too long; you may lose them. Don't hold answers to send in more than two sets at a time, or you may run out of lessons before new ones can reach you.

1. If a pulsating dc voltage which varies from 15 volts to 1 volt has a dc component of 8 volts, what is the peak value of the ac component?
2. What instrument is usually used by technicians to measure resistance?
3. Name the *two* types of resistors commonly used in electronic equipment.
4. If the current flowing in a circuit is 100 mils when the voltage is 50 volts, what will the current be if the voltage is reduced to 25 volts?
5. Draw a schematic diagram of a circuit showing a battery with 3 resistors connected in parallel across it.
6. What will the current be in a circuit where the voltage is 100 volts and the resistance 100 ohms?
7. Give the three forms of Ohm's Law.
8. In the circuit shown, the sum of the voltage drops across resistors R1, R2, and R3 will be (1) equal to, (2) more than, (3) less than, 100 volts.

EXAMS ARE NO SNAP: One comes with every lesson, usually looks like this (above). It was taken from an early lesson in

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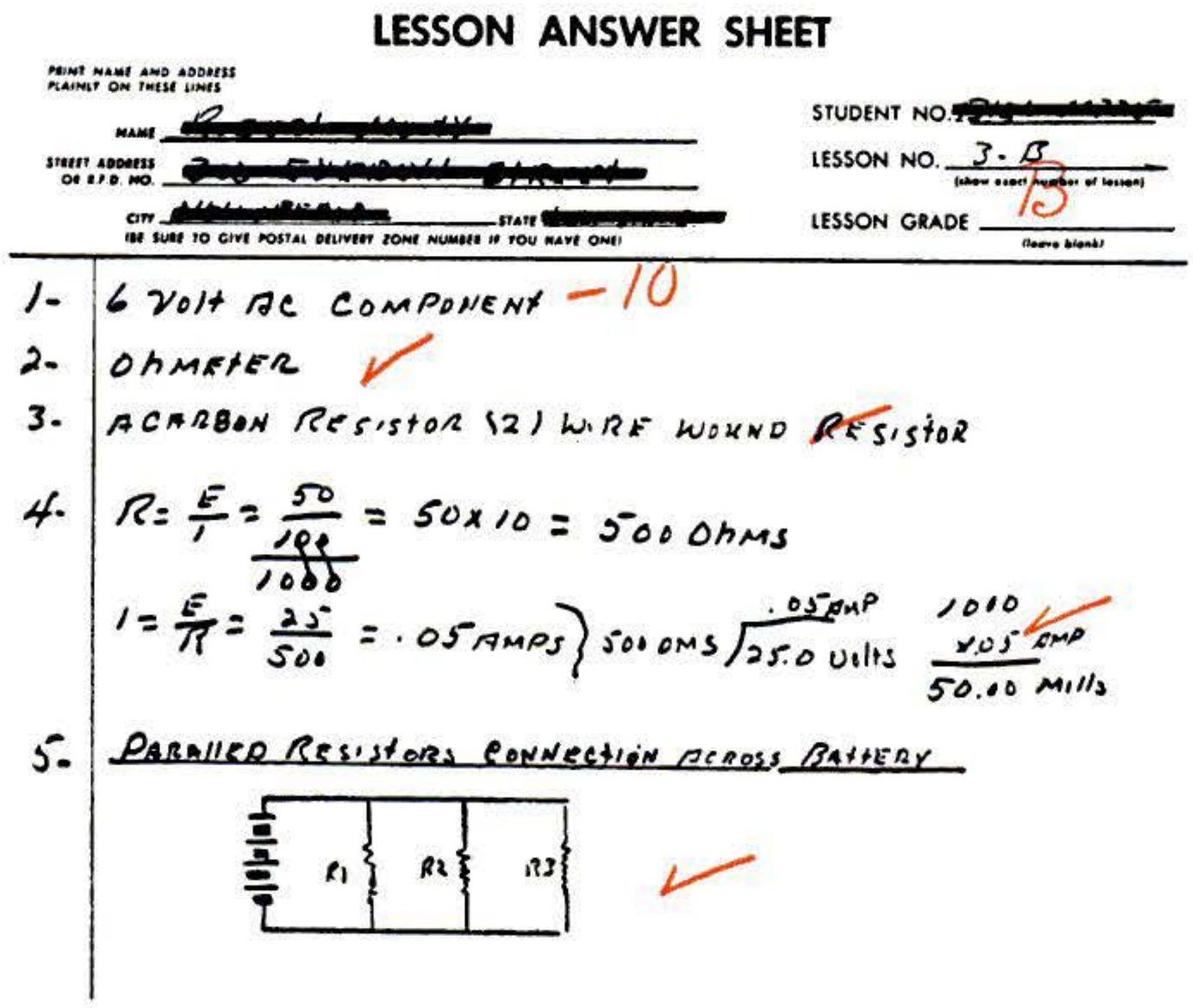
will prove useful and within your scope.

A very few private schools insist that you have a high-school diploma (55 percent of correspondence students do). But most have no set requirements for previous education. Their basic tenet is that they can train almost anybody. In general, they have made good on this claim. The first few lessons in all courses are elementary. In technical subjects, for instance, beginning lessons review high-school math.



LESSON ANSWER SHEET

PRINT NAME AND ADDRESS PLAINLY ON THESE LINES

NAME [redacted]

STREET ADDRESS OR R.F.D. NO. [redacted]

CITY [redacted] STATE [redacted]

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

STUDENT NO. [redacted]

LESSON NO. 3-B (show exact number of lesson)

LESSON GRADE B (leave blank)

1- 6 Volt AC COMPONENT -10

2- OHMETER ✓

3- A CARBON RESISTOR (2) WIRE WOUND RESISTOR

4- $R = \frac{E}{I} = \frac{50}{\frac{100}{1000}} = 50 \times 10 = 500$ OHMS

$I = \frac{E}{R} = \frac{25}{500} = .05$ AMPS } 500 OHMS / 25.0 Volts = .05 AMP; 1010 × .05 AMP = 50.00 Mills ✓

5- PARALLED RESISTORS CONNECTION ACROSS BATTERY

a TV course. Actual answer sheet from a Louisiana student is at right. He flubbed the first problem, but ended up with a B.

We pursued this point with some correspondence-school administrators. Suppose a man whose mathematical ability is limited to fourth-grade arithmetic wants to take a course in engineering or accounting? The usual strategy: Try to steer him into something simpler.

Some schools—particularly those specializing in art and writing—flatly refuse to accept students who obviously lack natural talent. But this attitude is rare. So don't overestimate your own capacity. Be realistic at the start.

The contract. The ones we examined (from large and reputable schools) were simple, understandable documents—no fine print, no legal gobbledygook. But they *are* contracts, just as binding on you as the installment paper you sign when you buy a car or a house.

One says bluntly that cancellation is not permitted—once signed up you are committed. Others permit cancellation, but still require payment of a sizable part of the total fee.

The cost, naturally, varies directly with the number of lessons. A course that takes a year or two —TV repair or a "unit" of engineering, for instance—runs from $200 to $300. The complete four-to-eight-year engineering course, preparing you to take the state exam for a professional engineer's license, would come to $1,000. By contrast, the average cost of attending a regular college is $1,600—*for one year.*

The fees generally cover everything—books, tools, instruments, experimental equipment. And you pay on the installment plan, as you study.

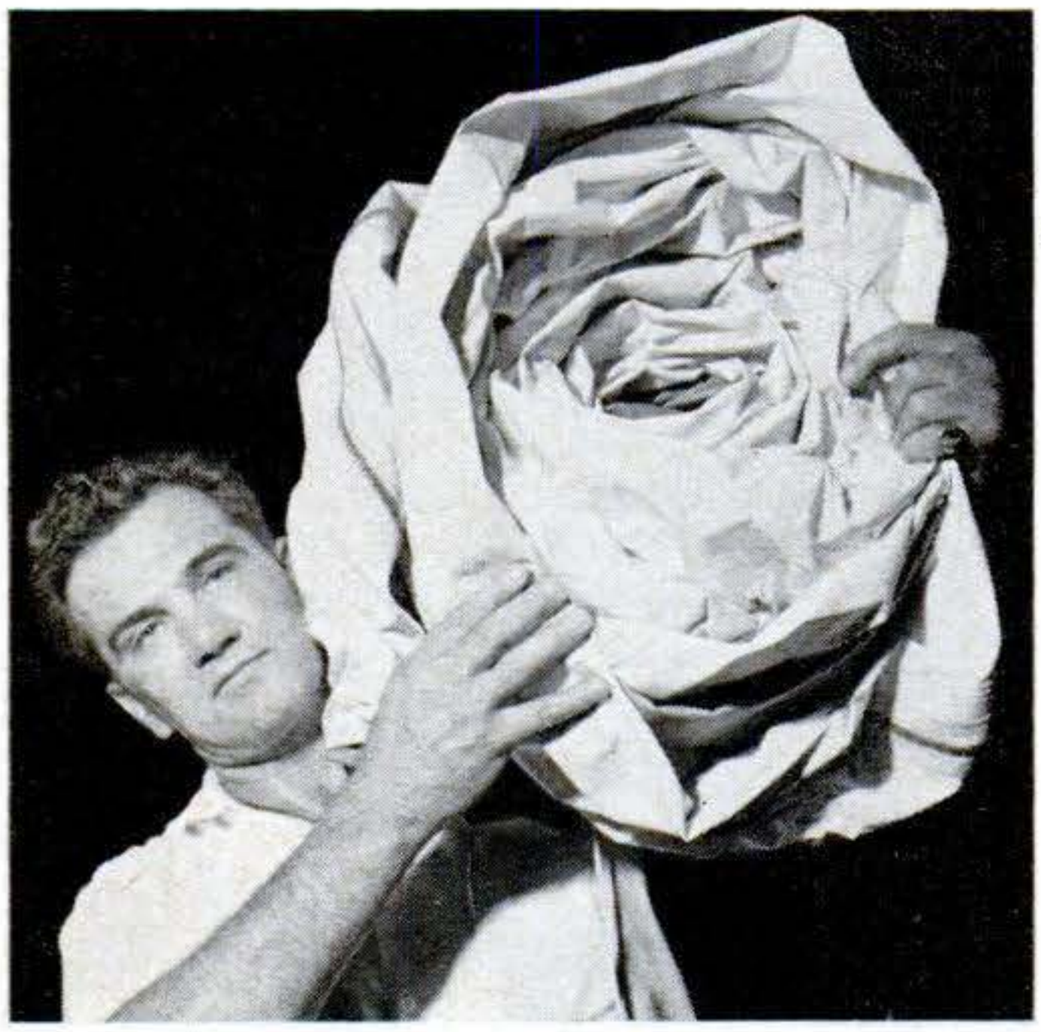
The lessons. They're really booklets, some running to 100 pages with full-color illustrations. Most are not so elaborate, though.

The writing is straightforward, the subject matter simply and logically developed. The schools' claim—that if you can read English, you can follow the lessons—seems well founded. Up-to-dateness varies; in general it's good. A text on portable radios, for example, covers transistor models.

The fetish of simplicity has its drawbacks. Take the case of an elementary lesson on one-cylinder gas engines (from a school that could *not* be considered among the best). After looking it over, one PS editor commented: "This is all right in a dogged sort of way. But the method leaves it up to the student himself to get beyond his own sticking points;

[Continued on page 278]

The Building One Man Can Carry



By George Laycock

LIGHT enough to tote on one shoulder, the bundle shown above can be ballooned into a weathertight and durable building measuring 40 by 80 feet. Paper-thin, vinyl-treated nylon does the trick. Inflated to mushroom shape with hardly more air pressure than you'd find in a soap bubble, it produces one of architecture's weirdest, yet up-and-coming structures—the "airhouse."

Today our armed forces and industry alike are finding a multitude of uses for these easily set up, highly mobile shelters —all based on a pilot model developed by the Cornell Aeronautical Laboratory in 1948. They're serving as radar shelters in the Arctic. They're being used as storage sheds by chemical, petroleum and steel companies. And according to John Whisman of the Irving Air Chute Company—a leading manufacturer of airhouses—the time will come when you'll watch outdoor movies and baseball and football games beneath huge protective domes of nylon. He also foresees a day when standard family camping equipment will include an air-supported tent, inflated with a tiny, battery-powered blower.

The big attraction of the airhouse to industry is its low cost. With the price of lumber, steel and masonry still going up, conventional structures for storage are expensive. But a 38-foot, hemispherical airhouse costs only about $1,600, including a blower.

There are other factors favoring the airhouse. It can be set up by unskilled labor. A crew of four men without training can erect a 40-by-80-foot model in four hours. Airhouses need no floors, and no special footings or other supports. If it's advisable to relocate them, you simply shut off their blowers, let them collapse, and carry them to the new site. They can even be placed on sloping ground, for they follow the contour of the land and form their own seals.

To erect an airhouse you simply stretch it out, fasten the bottom down with sandbags or metal strips and turn on the blower. Within a matter of minutes the building has expanded to full size.

The squirrel-cage-type blowers used for airhouses are usually nine inches in diameter and seven inches across. They're powered by ⅓-hp. motors. These run constantly to keep the structure erect, drawing about as much current as a 300-watt light bulb. Once the house is inflated, the blower recirculates the air within it, preventing any further build-up of pressure. This pressure, incidentally, is only slightly greater than that of the atmosphere outside.

This is one house where you don't dare leave the door open very long. But to prevent leakage, the doors need be nothing more than flaps that are sealed with zippers. More elaborate airhouses have either revolving doors or double doors with an air lock between them.

They're rugged. Already the users of airhouses have learned that hazards to

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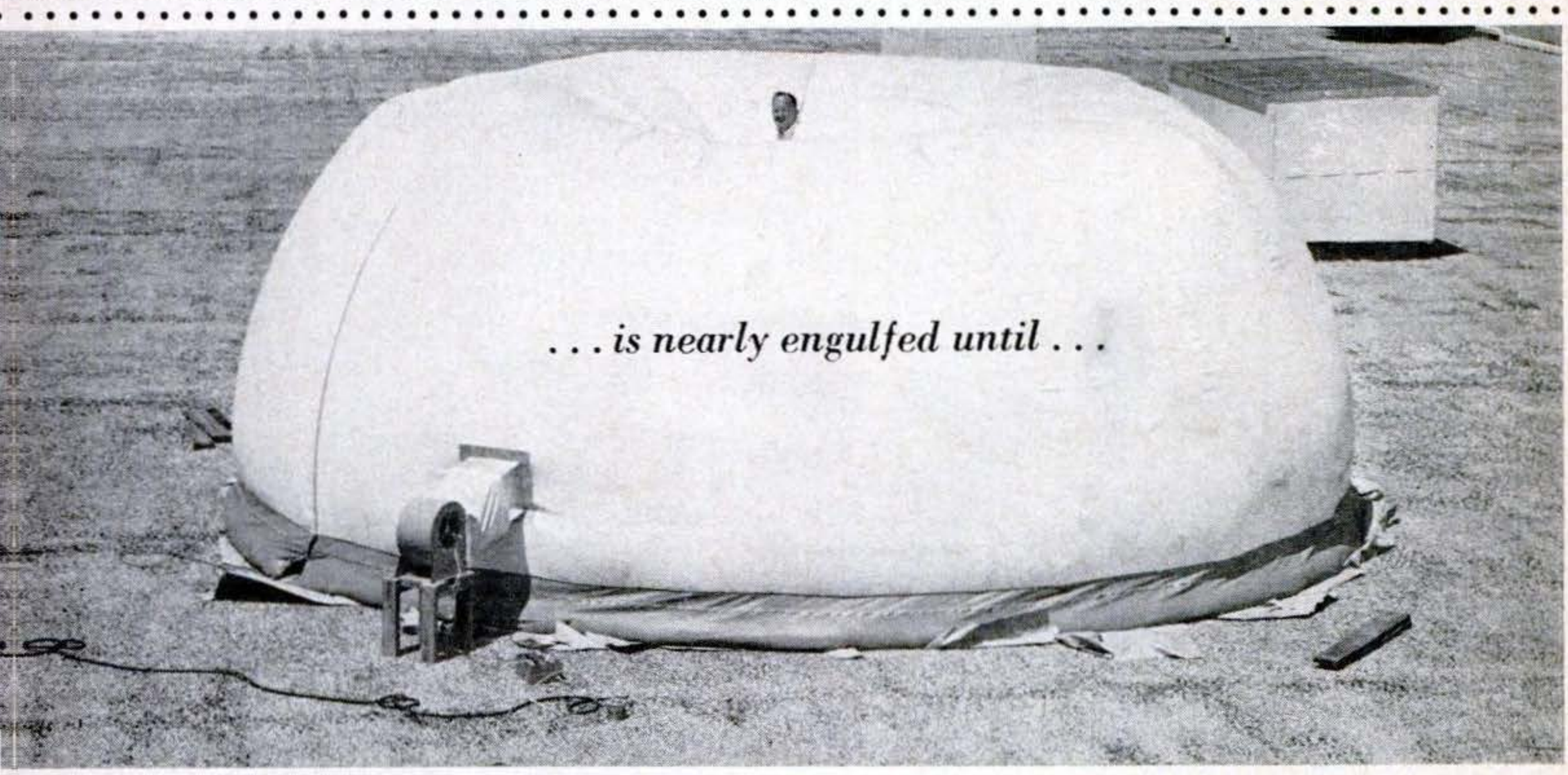
Man on a deflated airhouse . . .



. . . is nearly engulfed until . . .

. . . full pressure carries him aloft!

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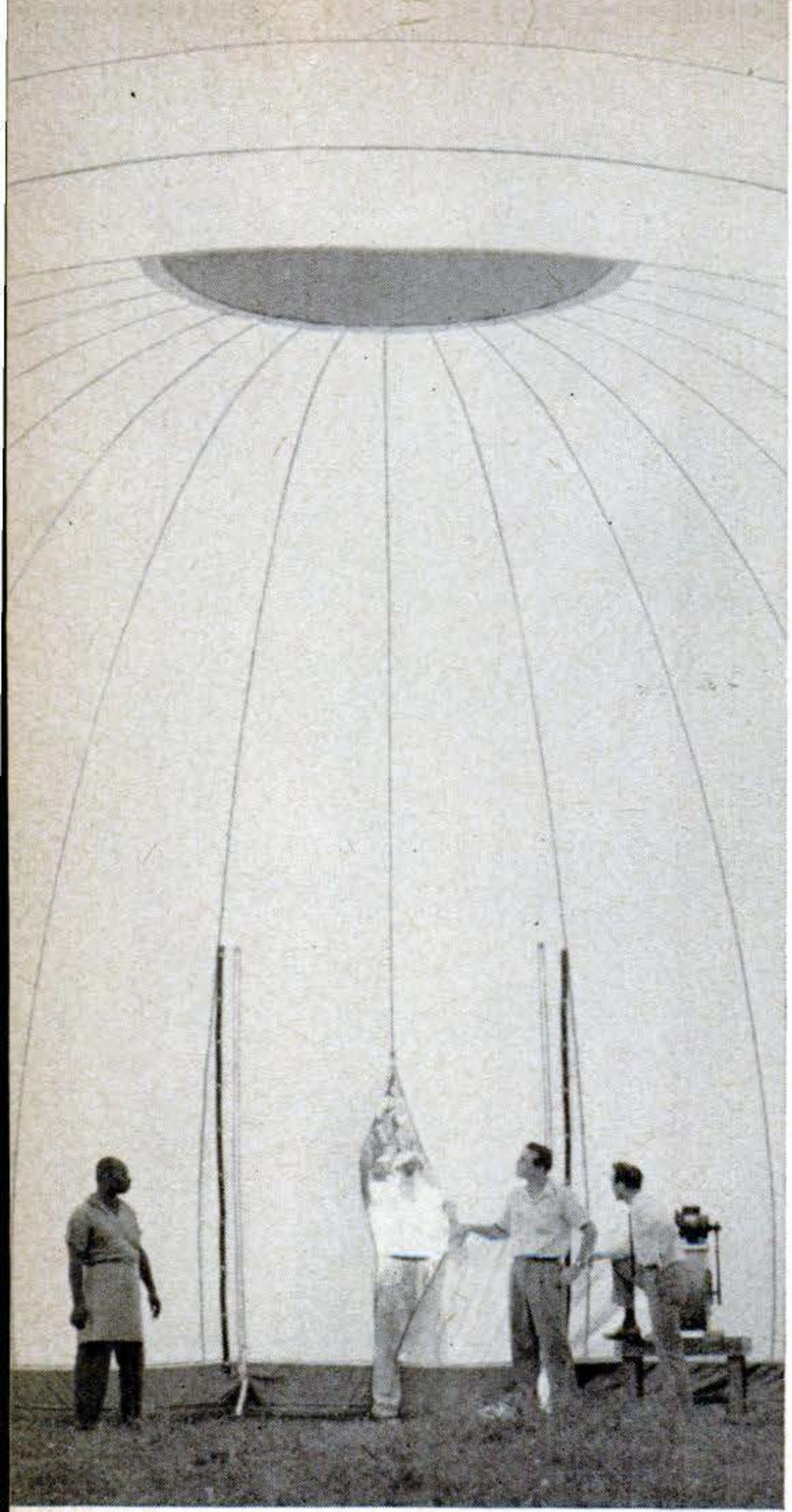

SIMPLE DOOR of this nylon igloo is a zippered flap that seals in air used for inflation.

DOUBLE DOORS with air lock between them let fork trucks enter this storage airhouse.

the strange-looking structures are fewer than they once imagined. A boy with a BB gun can't make a hole in the tough plastic. Even if he could, the tiny hole wouldn't deflate the house. Hail stones—even the largest ones—bounce off the material without injuring it. Heavy ice and snow are cleaned off by the shifting air pressure below. The added weight makes the fabric roll and bounce, and the load loosens up and slides off to the ground.

These inflated houses are so tough that workmen can lean ladders against them and walk around on top if necessary. They can even stand on them while they go up. When it comes to taking high winds, airhouses are better than many standard-type buildings. In the Arctic, where the armed forces have had plenty of experience with them, they've withstood blasts of 150 miles an hour.

Even an electric-power failure can cause little damage. The house simply settles down over the materials inside it. When the blower starts again, it balloons back into position. Should the fabric rip, it can quickly be repaired with a patching kit supplied by the manufacturer. This kit contains strips of the same material used for the house, along with cement and a brush.

One of the big problems still facing builders of airhouses is heating and air conditioning. This is still costly, as the thin nylon has poor insulative properties. On the other hand, air conditioners have been used successfully to keep some airhouses inflated.

Home builders are beginning to use airhouses to cover buildings under construction. With such weatherproofing, they can now work during the bad months that formerly brought building to a standstill. They can even purchase an expandable airhouse. As construction progresses, the airhouse covering it grows, too. It's this easy—you just zipper an extra section onto it.

Life expectancy of an airhouse is about seven years. It takes that long for ultraviolet rays to break down the vinyl coating on the fabric. But chemical laboratories are working on this problem, and the chances are good that airhouses of the future will last longer, further increasing the number of useful purposes they serve. **END**

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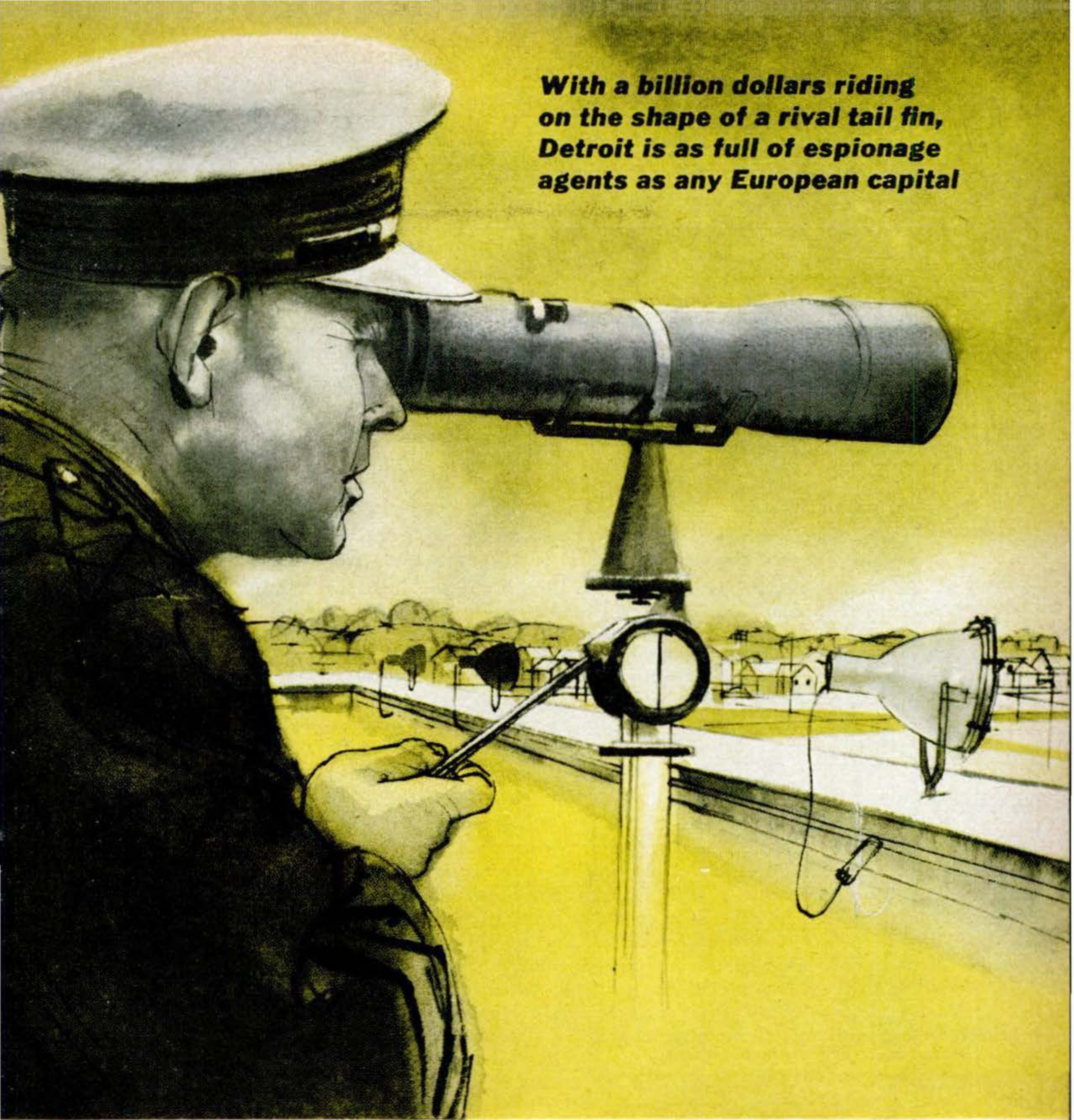

How the Auto Makers Spy on Each Other

By James Jones

NOWHERE is commercial spying practiced more assiduously today than in the auto industry. With billions of dollars in sales riding on the public's whims, and with as much as three years' lead time needed to ready a new model, an auto maker must know quickly and accurately what nasty surprises his competitor is brewing.

If Ford plans to move the transmission back to the rear-axle area in 1960, as some spies say, thereby eliminating the

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tunnel bulge, Chrysler wants to know how it's done. If Chrysler plans unitized bodies, as some spies hint, Ford wants to know how they differ from those on the 1958 Lincoln. If GM is engineering cantilever roofs, as some spies insinuate, everybody wants to know how and when. Hence, industrial espionage—and plenty of it.

Detroit intelligence agents achieve extraordinary success. Details of the 1958 models now on the road were known to all auto makers before mid-1956, in some instances before 1955.

Last July, Jack W. Minor, the Plymouth sales V-P, addressed 2,200 dealers. He showed them photos of all the 1958 cars—except Chrysler Corporation's. Idea: Let salesmen see what they'd be up against in the 1958 sales struggle. By then every other auto maker knew exactly what Chrysler cars looked like, and what engineering features they did and didn't possess.

"You concede that the competition is aware of your plans a year in advance," says C. Torrey Adams, the ex-FBI agent who directs Ford Styling Center security. Even the best protective screens break down by then because so many people have been cut in on the hot scoop.

The critical period is 18 to 48 months ahead of production. An auto maker who can steal a competitor's idea that early picks up a trump card. He has time (a) to apply the idea to his own products, or (b) to counter the idea.

"If I aim a punch at a guy's head," says Adams, "he can get set to block it. That applies here. If one company knows what another has coming, it can set up advertising and sales-promotion arguments in advance to counterattack."

The angles are many and devious. Take The Case of the Spinner Grille, a classic of auto espionage. Ford stylist George Walker designed a spinner—an airplane propeller-hub sort of thing—into the 1949 Ford. Then his agents turned up a photo of the 1949 Pontiac, also with a spinner in the grille. This was nine months ahead of Pontiac's introduction date.

Considering Detroit's knee-in-the-groin tradition, Walker could have smiled and kept his mouth shut. Ford was coming out first. Pontiac would have looked foolish presenting an apparent copy of a Ford design.

Walker, however, working on the theory that it's okay to maim the competition but not to kill them, boldly broke the news to GM's styling chief. It cost Pontiac a fortune to crash-program a new grille.

When Walker became Ford's vice president and director of styling, he ordered Adams to cinch up the security web. Adams began by reducing the number of people allowed to see advance models. Some 2,000 employees were then authorized to visit Styling; now it's 300.

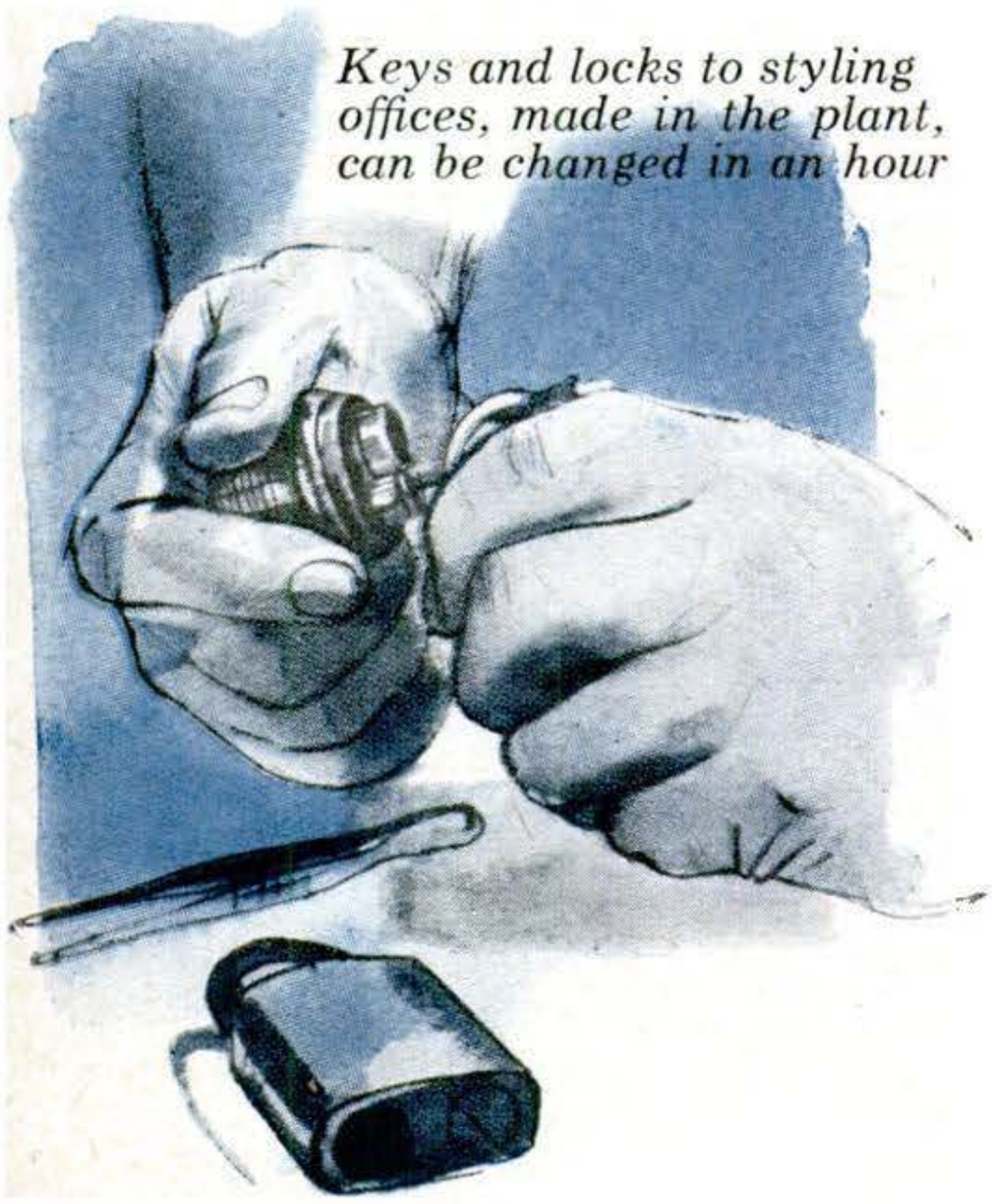
"We're trying constantly to reduce the number of exposures to new models," says Adams. "That way, you make information less clear and you slow down transmission."

Adams took other semi-military steps:

A badge system limits the movement of authorized visitors. Color codes bar visitors from sensitive areas.

The $11.5-million Ford Styling Center sits far back from main thoroughfares. Guards watch every visitor, wherever he goes. They even man a roof-top spotting scope to scan surrounding areas.

All keys are cut and all locks assembled right in the Center. Every lock could be changed in less than an hour. Waste-



Keys and locks to styling offices, made in the plant, can be changed in an hour

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baskets have locked lids. Their contents are burned at Ford's power station by guards. Obsolete mockups are crushed by bulldozers.

About the only place left from which spying can be done is overhead. Adams is studying baffles to screen the patio where mockups are viewed in natural light. "Even if nobody [in a plane or helicopter] is taking pictures," says one official, "you never can feel sure that they aren't."

The crudest spying techniques sometimes work. Take the Pontiac stylists who wanted a preview peak at the new Lincoln—in the sheet-metal, not just in photos. Carrying rolls of blueprints, they marched boldly through a side door of the Lincoln plant posing as Lincoln employees, and casually strolled down the assembly line.

Unfortunately, a Lincoln supervisor had once worked for the Pontiac men. They saw each other at the same time. The Pontiac interlopers wanted no truck with their ex-colleague—not while trespassing, anyway—but he ran after them to say hello. What followed looked like a Laurel and Hardy movie. The Pontiac stylists dodged around the assembly line, backtracked, and dived through strange doors before escaping.

One of the main loopholes in security is people. They talk. To lock loose lips, Adams runs a persistent educational program. Everyone is taught that leaked data can easily hurt Ford—and the jobs of Ford people.

"Some of the greatest leaks, I'm afraid, come from the top," said one Big Three official. "The brass will be gathered at the Detroit Athletic Club or Bloomfield Hills Country Club, at a party or in a locker room, and accidentally let fly with some secret of more than passing importance."

Sometimes a slip of the tongue tips off more than the boys in the locker room. During a press preview of Chrysler's 1954 cars, Chrysler president L. L. Colbert was asked if the corporation planned a sports car. Colbert said no, then added: "I suppose all you fellows know that Ford is going to build 15,000 sports cars next year."

The fellows didn't know, but sure enough, along came the Thunderbird.

Even security-wise engineers get mousetrapped. It happened to George Huebner, chief of Chrysler's automotive gas-turbine project.

Priceless secrets of futuristic models die with the mockup—crushed by a bulldozer

He was test-driving the still-secret turbine in an innocent-looking 1954 Plymouth. One evening he took the car home. His young son David badgered him for a ride. Huebner agreed. And how about the kid next door? Okay.

But when they stopped for the neighbor's boy, waiting there, too, was the neighbor himself—a well-placed executive in a competing company. He got in, knowingly eyed the elaborate instrumentation and went for a ride. "What could I do?" says Huebner.

All auto makers deny that they pirate competitors' employees to pump them, but it's public knowledge that stylists and engineers are as mobile as the Detroit Red Wings hockey team.

On the one hand, a company man states, "We would not hire a man who came to us with competitive data to sell. He might leave us in a few months and go somewhere else to sell."

On the other hand, an ex-Chrysler

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stylist revealed that he devoted his first two months on a new job to sketching what he could remember of "Forward Look" designs for the future.

Another rich lode thoroughly picked over by spies is the Rackham Building, headquarters of the Engineering Society of Detroit and meeting place for the Society of Automotive Engineers and other professional groups. An intelligence operative, armed with an expense account and membership in one society or the other, can cement friendships with any number of engineers. Over a casual after-meeting beer, any number of tidbits can be netted.

Conventions of machine-tool builders, glass manufacturers and other automotive suppliers are also religiously attended by the snoop-and-poop forces. They meander from one hotel hospitality suite to another, sipping neighborly drinks, making small talk—and getting the lowdown on what the competition is working on.

Detroit's many small tool-and-die shops are a milk-run for the agents. Says one spy: "We had the word almost immediately last year when GM kicked off a crash program to revise some of its '58s. Every die shop in town suddenly filled up."

Spy headquarters (called "competitive data" or "advanced product planning" offices) are hidden in the engineering department or the industrial-relations section, out of which security forces operate. Here is where the real pros spend every working hour compiling, discarding and interpreting news of the opposition's plans.

Contrary to common belief, these agents are all known to one another. Within limits, they freely exchange knowledge.

Much of the work consists of telephone calls between competing spies, who ask outright about future cars. One rule remains inviolate: The spy never goes directly to the competitor about whom he wishes to inquire, and he never talks about his own company's future products. But he'll spill all he knows about anybody else's dream stuff. Thus, a conversation between a Studebaker-Packard agent and a Chrysler spy might go this way:

S-P: "Did you know that Buick has frozen the design of that new transmission we were talking about?"

Chrysler: "No, I didn't. Very interesting."

S-P (tactfully): "By the way, can you tell me whether Mercury has discarded the spare tire for '59?"

The Chrysler man may know—and tell. At the same time this discussion is going on, Ford and another Chrysler agent may be exchanging dope about Pontiac and Rambler. Information has been traded; quid pro quo has been maintained—and "secrets" flow as steadily as Chevys off an assembly line.

How does a spy get in the business? One described it this way:

He had been working as an engineer in a nonautomotive division of his company. He was given a temporary job in an auto division (to test his engineering qualifications). Then he was invited to join the espionage staff. He hadn't any notion of where a spy even begins to spy.

Shortly, he was invited to lunch with two engineers from two other companies. Conversation was casual, seldom touched on business. Soon after, though, one of his luncheon companions phoned to ask if he, perchance, knew that XYZ Corp. planned a clear-plastic roof insert for 1960. No, he didn't. Before the conversation ended, his caller discreetly inquired about a suspension under development at yet another company. The files he had inherited produced the information.

Then he began receiving envelopes bearing no return addresses, but containing pictures and specifications of competing cars. Who sent them? The guy who telephoned next day for information about a different competitor. That's who. Our hero was in business.

Within a few months, his files of secrets bulged like John Foster Dulles' briefcase. (If this revelation of bold, bald blabbering is disappointing and deglamorizing, we're sorry.)

Why spy? Sure, information is traded—but never about the trader's own company. The massive intelligence effort is worthwhile because of the billion-dollar stakes the industry gambles every year. There's always the hope that you can play your own hand close to your chest—but divine what cards the other guy holds. **END**

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What Science Is Learning About Headaches

There's no simple solution to this age-old curse, but now research has turned up some good advice for chronic throbbers

By Milton Silverman

RECURRING, chronic headaches today afflict nearly 20 million victims in the United States.

They represent a major cause of absenteeism in American industry, hitting hardest the intellectually superior workers.

They mark a major mystery to doctors, and have caused one physician to remark, "If I wished to show a student the difficulties of medical practice, I'd give him a headache to treat." They are enigmas.

And to Western civilization, they serve as the most impregnable of all social excuses, enabling millions of men, women and children to avoid unappetizing parties, committee meetings, delicate family conferences, and even homework.

Who gets headaches? Last summer, at the annual convention of the American Medical Association, Dr. Henry Ogden of Louisiana State University revealed that these painful attacks seem to follow

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a strange but suggestive pattern. On the basis of a study of 4,634 subjects, he found that headaches—including the common, non-chronic variety—were reported by about 60 percent of the general population: 71 percent of the women and 51 percent of the men. They were strikingly more common among the young rather than the old, among the single rather than the married, among the educated rather than the unlearned, and among executives and professionals rather than salesmen, manual workers and farmers.

"It is obvious," one medical observer declared, "that the best treatment for headache is to be an unschooled, happily married farmer aged 80 or 90. Unfortunately, this is a treatment which I can only rarely prescribe for my patients."

To the host of patients who suffer constantly from headache, and to their friends and relatives who suffer with them, the most desirable prescription would be a pill, an injection or a surgical operation that would end the ailment once and for all. In spite of thousands of years of study, except for a few special conditions, medicine has turned up no such simple answer. Medical men have investigated headache by using professional head-standers, putting human volunteers into giant centrifuges, dosing them with hundreds of possible headache-producing chemicals, pulling and probing exposed brain tissues in conscious patients undergoing brain surgery, and injecting gases and liquids to build up pressure inside the skull. But even after all this research, doctors are not completely agreed on the machinery involved in the most common varieties of headache.

What causes that throbbing? Contrary to a widely held belief, most headaches are not caused merely by increased pressure in the head. The cranium can stand remarkably high internal pressures without producing symptoms. Probably the most important mechanisms, Dr. H. Houston Merritt of Columbia University stated a few months ago, are distention and swelling of blood vessels within the head, inflammation around the head arteries and nerves, and direct pressure on the nerves in the head and neck. Any one of these alone, or a combination of them, can result in misery.

But what triggers these mechanisms? Where should we search for their cause?

If there is any agreement in this hotly controversial field, it is that most headaches have no single or simple cause. A headache is not a disease in itself, but—like fever—is a symptom of disease.

During the past few years, medical researchers have come closer to an understanding of the basic ailments that may hide behind a headache. In more than 90 percent of all cases, headaches are *not* connected with brain tumor, brain infection, hardening of the brain arteries, trouble in the eyes, nose, sinuses, ears or teeth, a hit on the head, or even the frequently blamed stomach upset.

"Constipation and gastrointestinal disturbances are reputed to be a common cause," said Dr. Merritt, "but their importance has been greatly exaggerated."

This does not mean that all these and other factors may not have some significance. There is ample evidence that eye strain, hunger, sinus infections, overeating, loss of sleep, and overindulgence in alcohol may serve as aggravations. But in most headache patients—at least, in most of those desperate patients who go to a doctor for help—none of these can be indicted as the arch-criminal.

With more than 90 percent of these chronic sufferers it now seems that two major types of disorders are involved. One is the so-called tension headache. The second is the notorious migraine headache. Each has different characteristics, which most patients and nearly all physicians can recognize, and each usually requires different methods of control.

The tension headache is probably the most common of all. It occurs more frequently in women—or, at least, women more often go to their doctors about it. It is only rarely preceded by any warning signs. It hits frequently, and 30 percent of the victims complain of daily headache. The pain usually starts at the back of the head, moves forward and involves both sides, and is described as a combination of burning, pressing and throbbing.

The typical victim says, "It feels as if my head were in a vise."

Sometimes the pain is violent and completely crippling. But at other times, a panel of experts stated recently, there is "a tendency of the patient to exaggerate the extent of the headache, to portray

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it in melodramatic terms and to boast of the suffering he is compelled to endure. . . . However, such headaches rarely interfere with work, play or sleep."

Behind these headaches is usually a case of emotional tension—of worry, anxiety, fear or nervous strain. "These are tensions that would normally make a person blow his top," says one psychiatrist. "But the headache patient doesn't blow his top. He bottles up his tensions and gets an ache in his top instead."

Many sufferers are inclined to blame their symptoms on such obvious indiscretions as smoking too many cigarettes. But several investigators claim it is usually some underlying emotional pressure that is causing both the excessive smoking and the headache.

Some victims are inclined to interpret their symptoms as a sign of impending insanity. They may think, "Maybe I'm losing my mind." But there is no particular relationship between headache and insanity; as a matter of fact, patients in mental hospitals have been found to be remarkably free of headaches.

Relax and feel worse? So-called tension headaches sometimes appear just at the time when tension seems to be suddenly released. These involve what some doctors call "relaxation headaches"—the Sunday headache of the businessman, the Monday headache of the preacher, the day-off headache of the nurse, and the post-examination headache of the student.

Once a tension headache starts, the pain can usually be relieved by a pill. In some cases, any pill will work. For example, during a New York study involving more than 5,000 subjects, it was found that placebos—inactive "dummy" pills—reduced the pain in about 55 percent of the victims. More help, however, was obtained from aspirin or some other pain-killing compound, sometimes given in combination with a mild sedative. In the New York study, the best results—71 percent of the patients relieved—were recorded with such an analgesic-sedative combination.

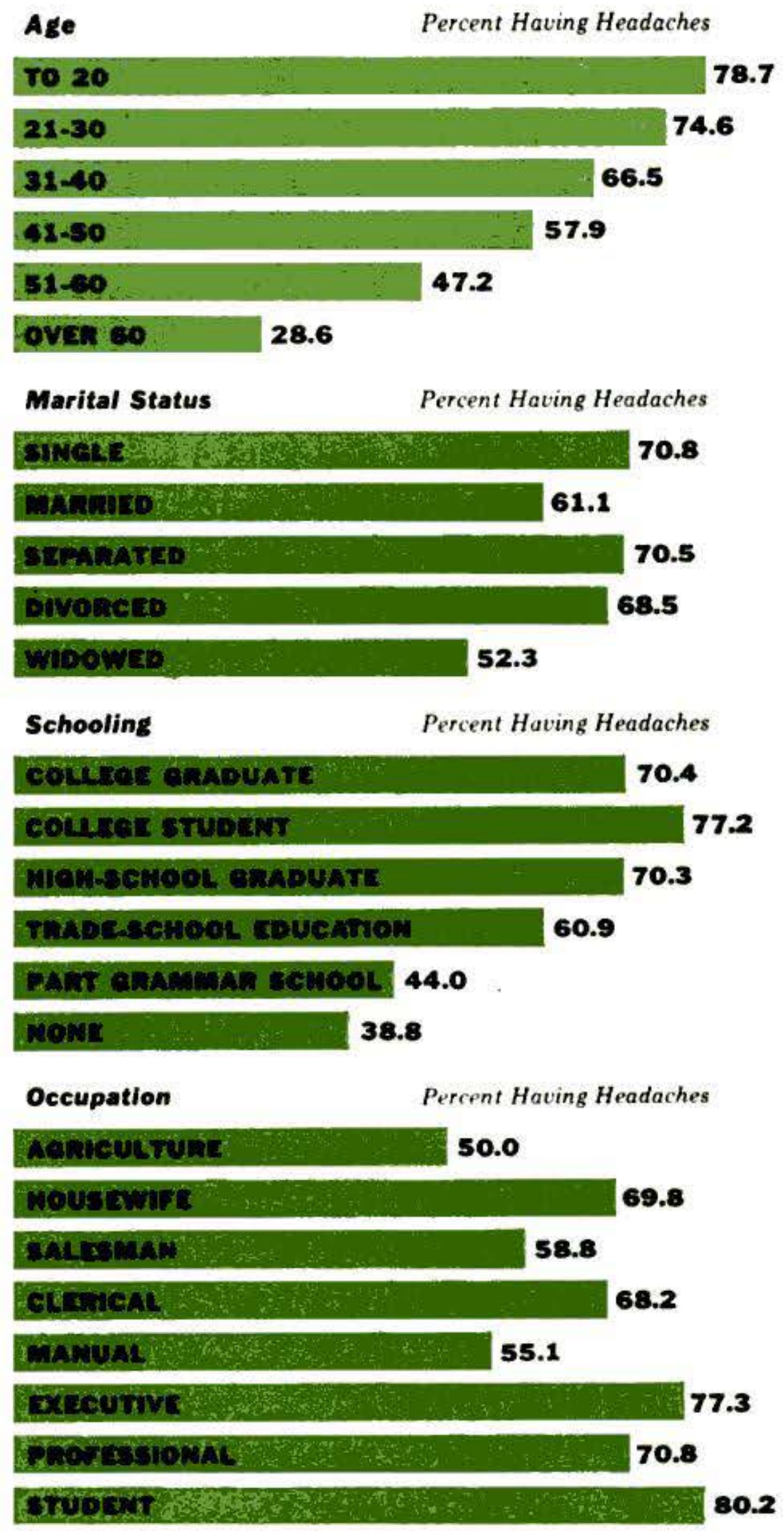
Stopping such tension headaches is one problem. Finding a way to prevent them —to get permanent relief—is even more difficult.

"A person with a headache," claims Dr. Louis Moench of the University of Utah, "may find himself on an excursion to an ophthalmologist, otolaryngologist, neurologist, dentist, psychiatrist, osteopath and chiropractor. Thereupon, he is X-rayed, massaged, fitted with glasses, relieved of his turbinates and teeth, and too often emerges with his headache intact."

Well-meaning friends—or not-so-well-meaning enemies—may confuse tension headaches with imaginary illness, or accuse the victim of shamming or goldbricking. But, as millions of pain-stricken patients know only too well, and as many of their friends and enemies eventually discover for themselves, there is nothing imaginary about tension headache.

What about tranquilizers? In some instances, the tension can be temporarily

Who gets headaches most? Here's how groups compare



From *Your Headache* by Henry D. Ogden, M.D.

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relaxed by the regular use of these drugs. One such compound, Miltown, was introduced as a general tranquilizer after a Florida psychiatrist first found that it prevented tension headaches. But the problem is not permanently solved until the patients learn how to live without excessive tension—to solve their marital problems, understand their children and their in-laws, get along with their fellow workers, and learn how to accept themselves and their environment.

One victim of constant tension headaches, for instance, found his pain stopped when he finally admitted to himself that he would never set the world on fire, but nevertheless could have a perfectly satisfying career as a good husband, father and citizen. Another—a hard-driving, energetic young man constantly racing against deadlines—found the answer to his problem by having a serious heart attack.

"It wasn't having the attack, or surviving it, that cured my headaches," he said later. "But afterwards, when I learned to relax and live an easier life to spare my heart, I found my headaches had disappeared."

The migraine headache is the second most common variety. Just as with tension headaches, emotional factors are also believed to play a key role in setting off these attacks. This awesome form was recognized at least 5,000 years ago, and ancient Babylonians attributed it to the activities of a demon named Tsihatho.

While tension headaches most often begin without warning, migraine headaches are usually preceded by one or more ominous signals. A few hours before the pain strikes, some migraine sufferers feel oddly depressed or irritable, while others become suspiciously happy and elated; one patient, for example, recognized this latter warning sign by observing, "I feel dangerously well today." Still others usher in their bouts by dizziness or nausea.

Once the actual headache begins, it is usually limited to one side of the head —the word migraine comes from the Greek *hemi,* for half, and *krania,* for skull—and is almost always described as a throbbing pain.

Migraine occurs much more frequently in women, with approximately five female to every two male victims. In nearly two-thirds of all migraine patients, there is a record of the disease in other members of the family. It has been found in children only 18 months old.

Migraine has been blamed on everything from allergies, nicotine, alcohol, vitamin deficiencies and hormone imbalances to neck strain, eye strain, and constipation. Some of these factors, notably certain allergic reactions, may play a contributory part; but there appears to be no generally accepted evidence to show that any of them plays the major causative role. Instead, according to Dr. Arnold P. Friedman, chief of the famed Headache Clinic at Montefiore Hospital in New York, doctors are now beginning to realize that there is a psychological pattern characteristic of migraine victims.

"In recent years," he told a medical meeting, "studies have indicated that many patients with migraine are meticulous, neat in appearance, rigid in their thinking, and excessively aggressive toward their environment."

Other workers have described such people as unyielding perfectionists who demand a flawless performance from everybody, especially themselves.

In past years, almost every major specialty in medicine has temporarily adopted migraine as part of its medical domain and reportedly found a "cure" for it. Ophthalmologists have claimed that correcting vision gave relief to more than 90 percent of the victims. Allergists have announced cures or dramatic improvement in 50 to 80 percent of migraine cases by desensitizing the victims, or keeping them away from offending pollens or foods. Bone surgeons have claimed 85-percent success by applying traction to the neck. Endocrinologists have described excellent results with sex-hormone treatments, and internists have noted equal success with injections of vitamins or minerals. Such brilliant but generally unconfirmed assertions have caused some observers to wonder whether the "cured" patients were really migraine victims in the first place.

What stops migraine? Patients with true migraine, when stricken by their aches, are rarely helped by any dummy pills. Ordinary headache remedies give them little relief. For them, the most effective compound appears to be a chemical that has no direct effect on pain

[Continued on page 236]

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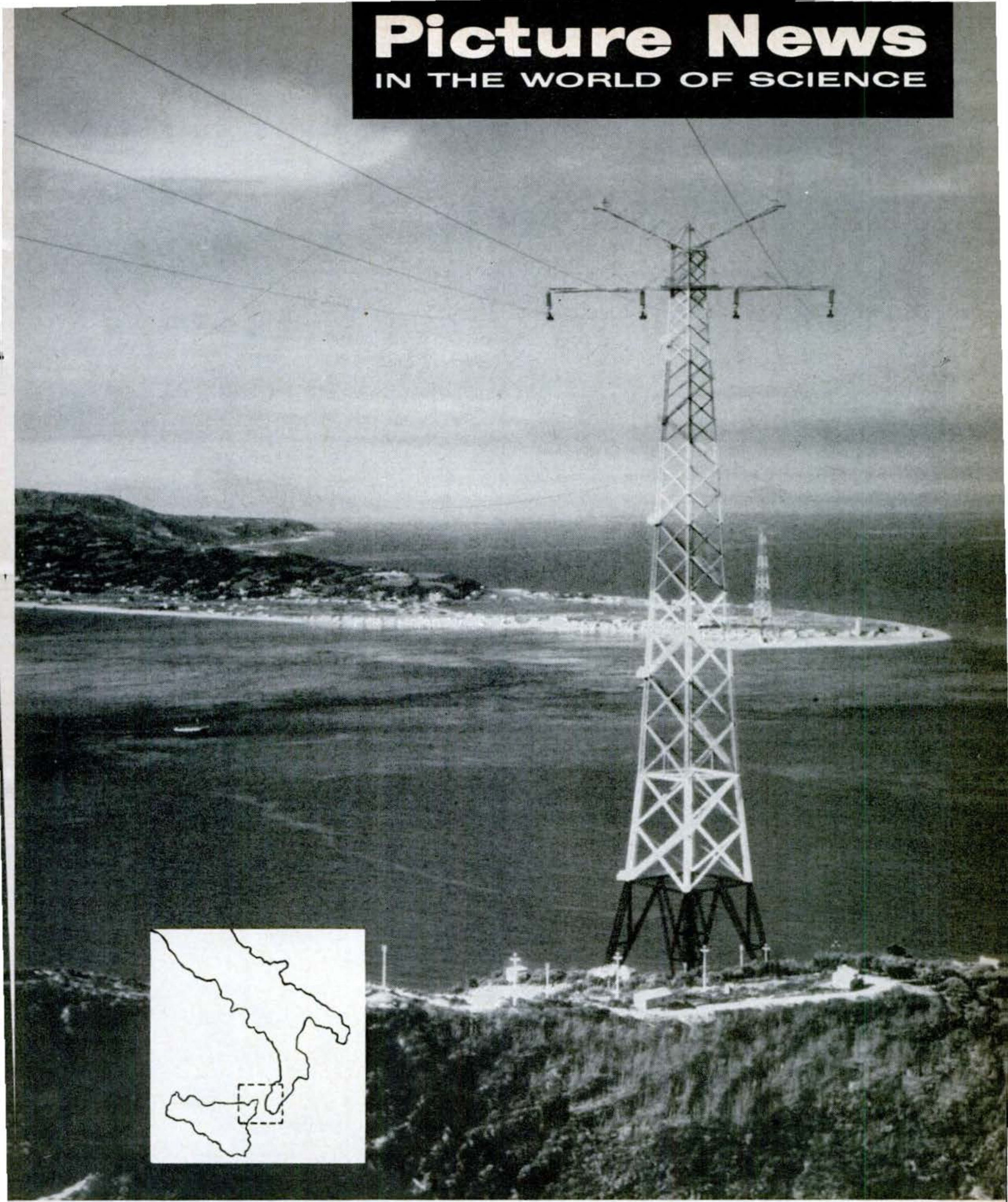

Giant line carries power across Straits of Messina

STRETCHING between Scylla and Charybdis, rock and whirlpool of Homer's epic, this 220,000-volt power line between Italy's boot and Sicily is an engineering wonder. Built by the Societa Anonima Elettrificazione, its 740-foot towers, 11,985 feet apart, carry steel and aluminum cables dipping to 230 feet above the sea to stand wind and seismic stresses.

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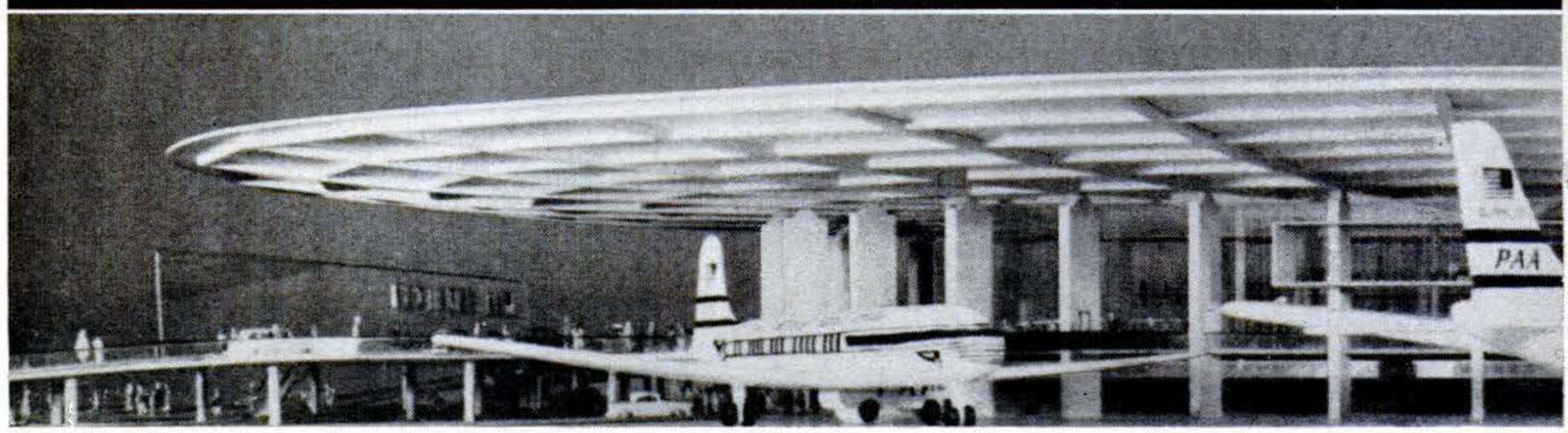
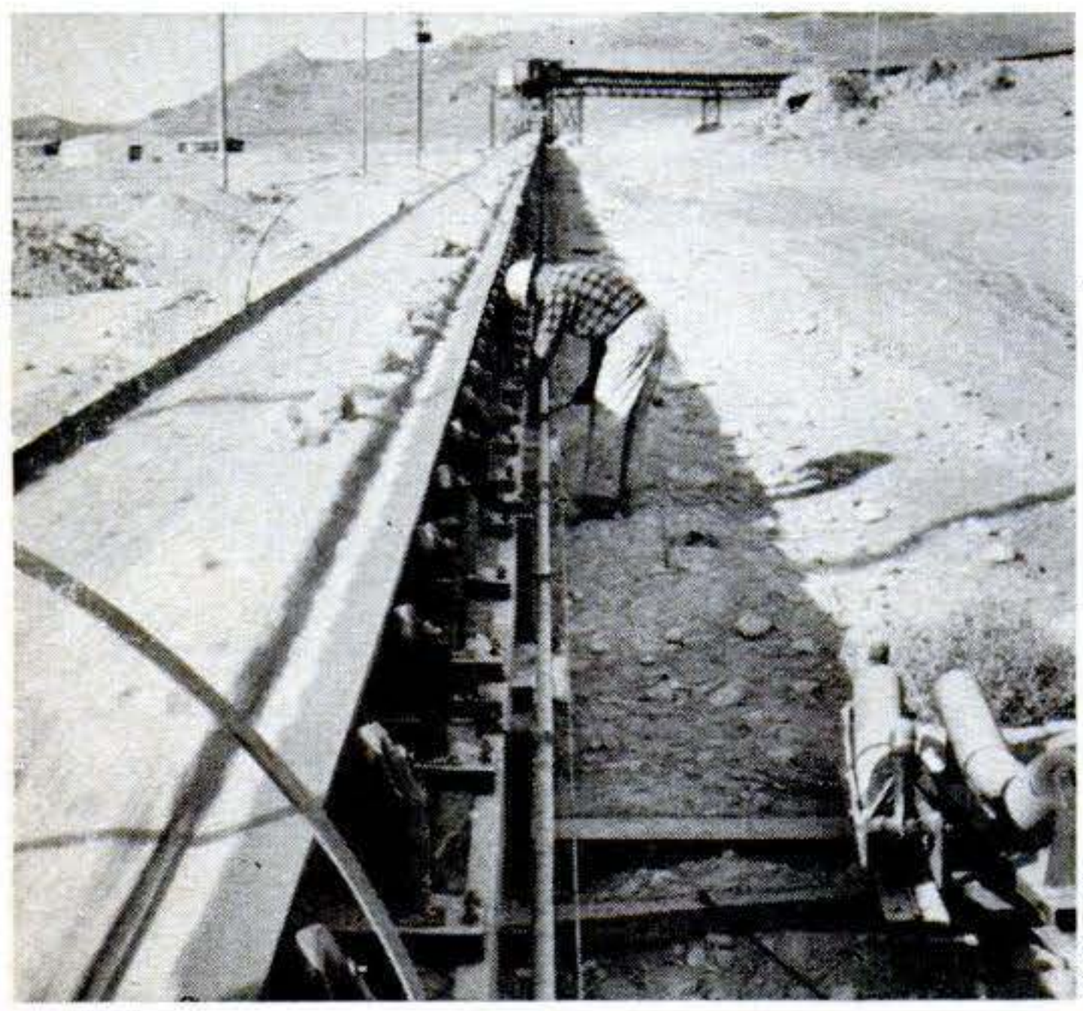


Jet age coming: they're soundproofing an air terminal

How do you spare the people in the waiting room the din of taxiing jets? The answer, in Pan American's new terminal (shown in model above) at the New York International Airport, is soundproofing for the

Mountain moves two miles; becomes roadbed in lake

A TWO-MILE conveyor system (below, left) moves 83,333 tons of gravel a day from a mountain to barges (right) to be used as fill for a 13-mile roadbed for the Southern Pacific across Great Salt Lake. Main belts take loads up to 5,000 tons an hour, travel 850 feet a minute.



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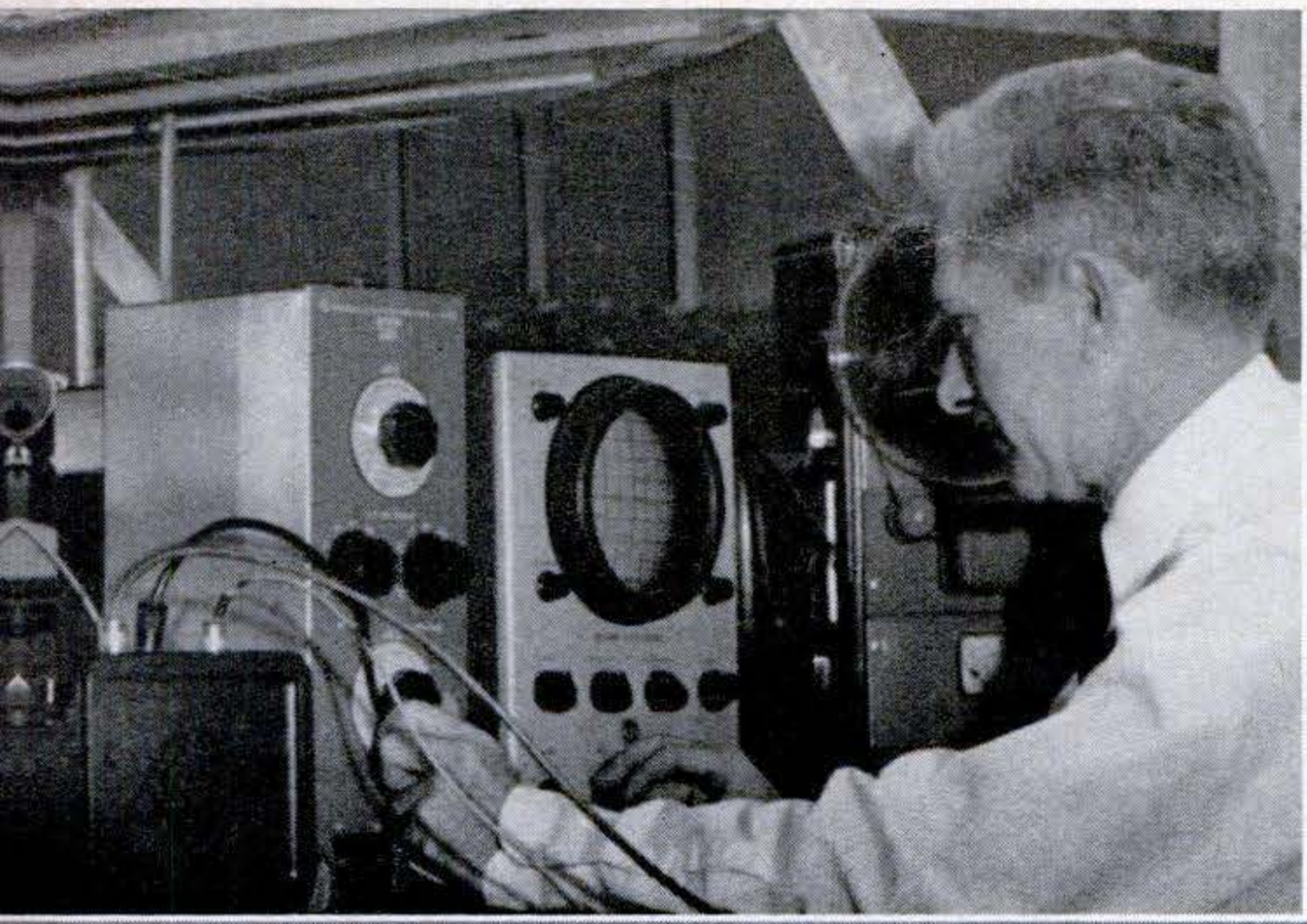

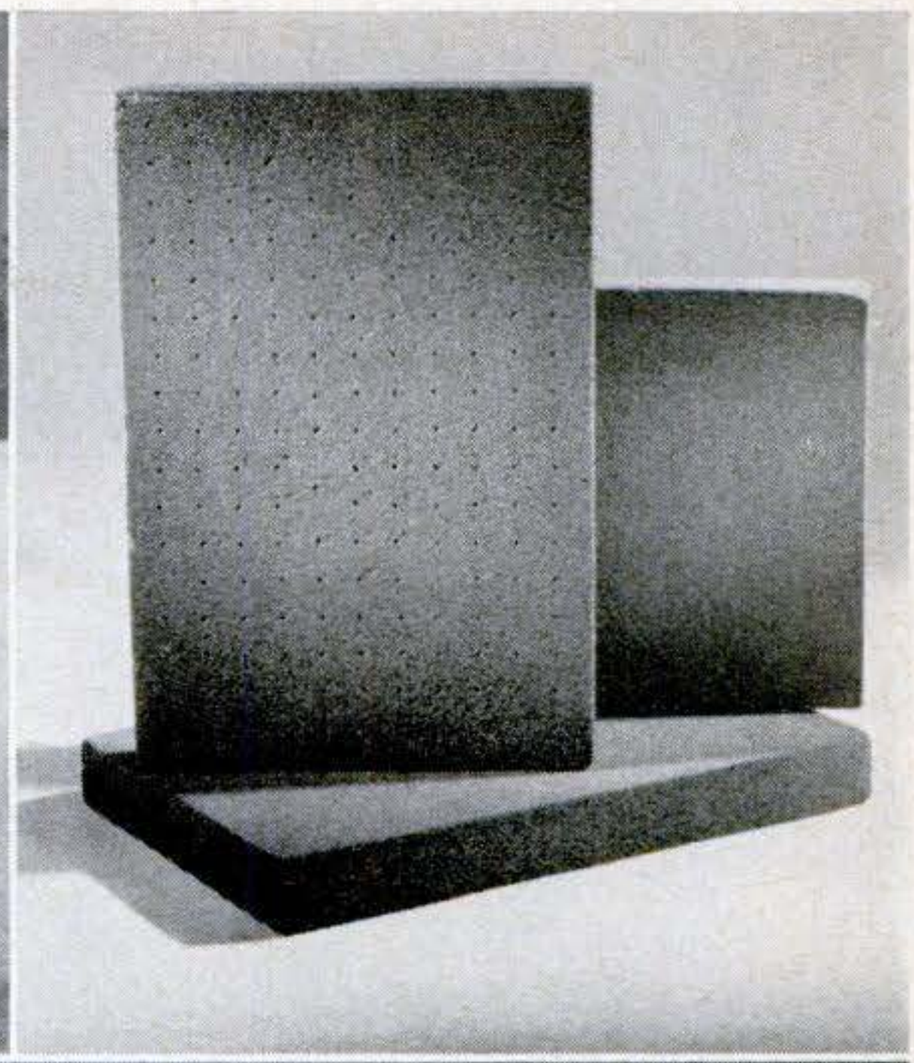

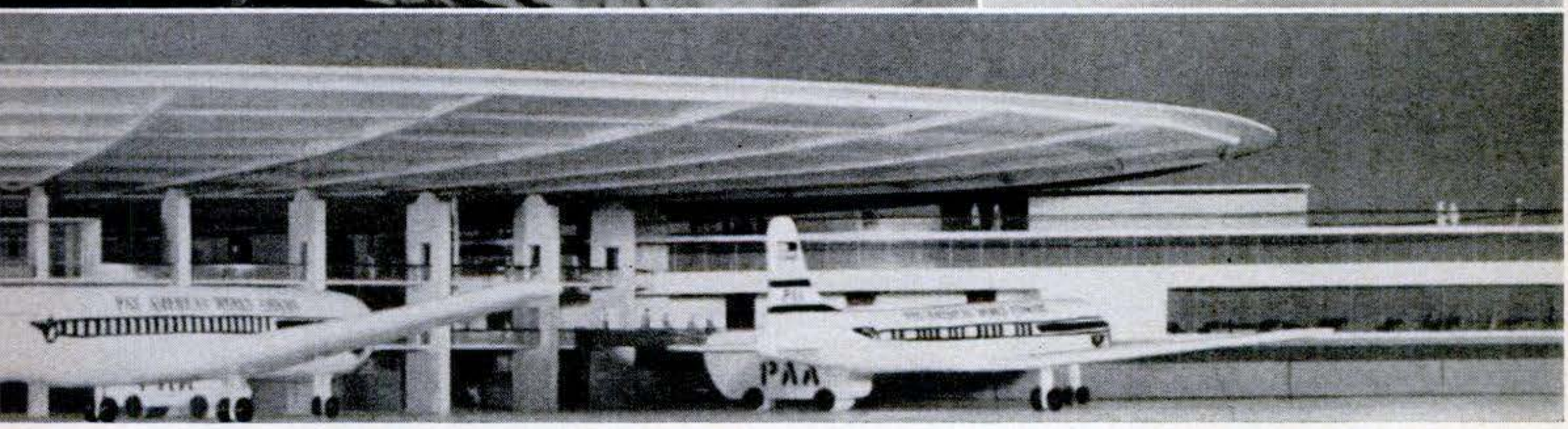

underside of the cantilever roof. At top, R. L. Cardinell, member of the acoustical engineering firm of Lewis S. Goodfriend, Montclair, N. J., tests noise recordings in a 1/40 scale model. At right is a sample of two-inch Foamglas developed by Pittsburgh-Corning for use on this jet-age job.

VTOL airliner is both helicopter and plane

THIS British Fairey Rotodyne takes off and lands vertically like a helicopter and cruises on fixed wings. It runs on two 3,500-hp. forward-driving turboprops that also supply jet power to drive the rotor blades. Top speed is 200 m.p.h., range 400 miles. It carries 48 passengers.

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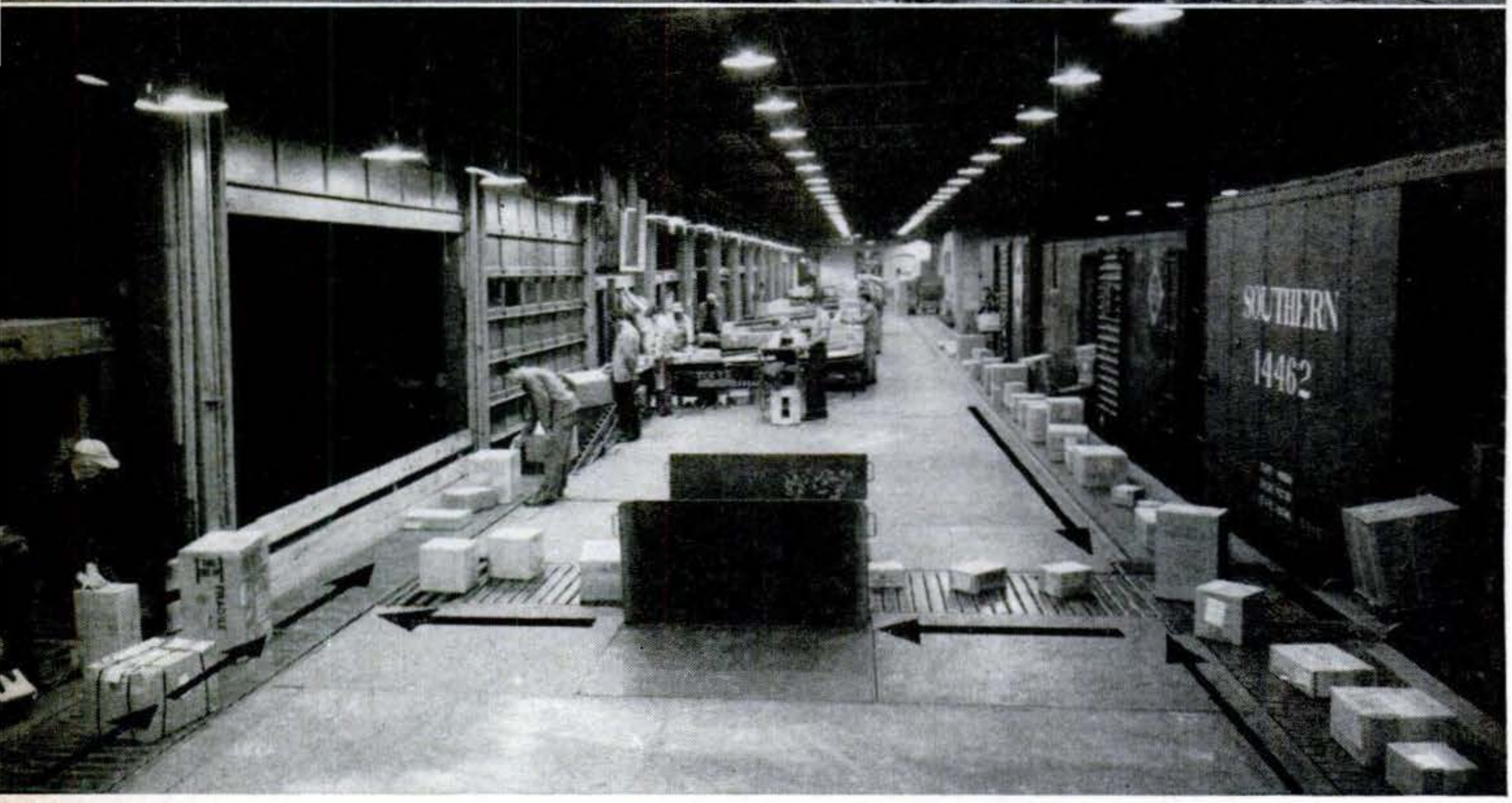
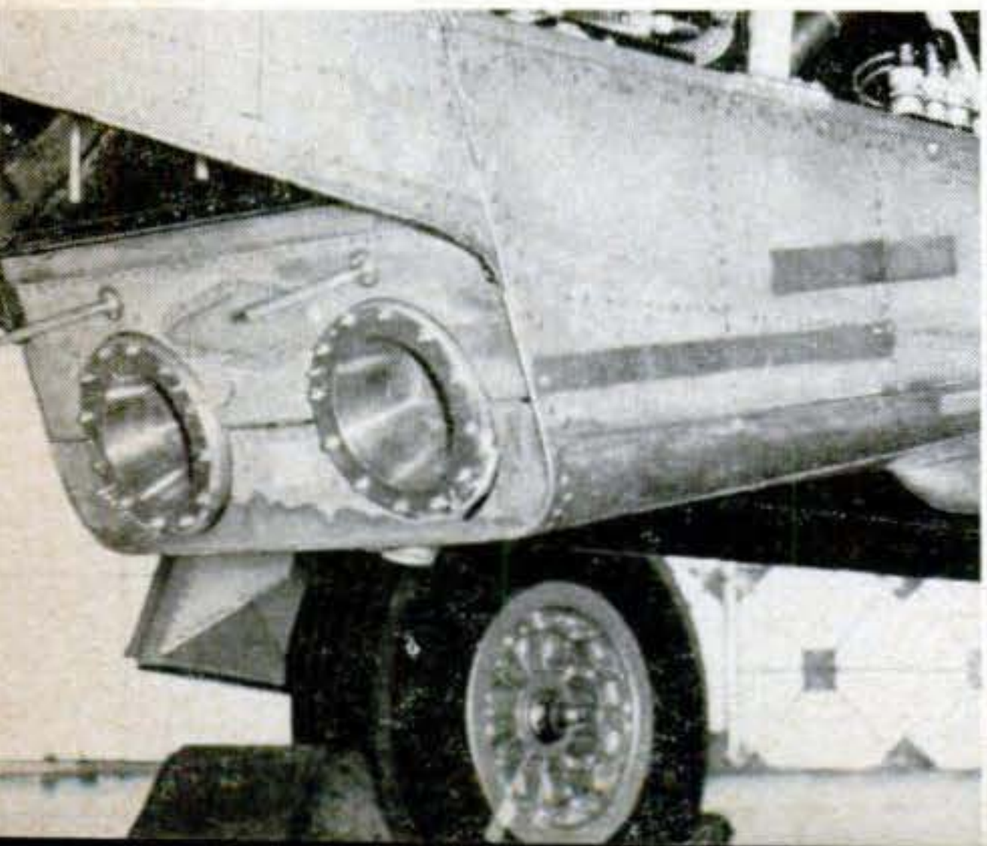


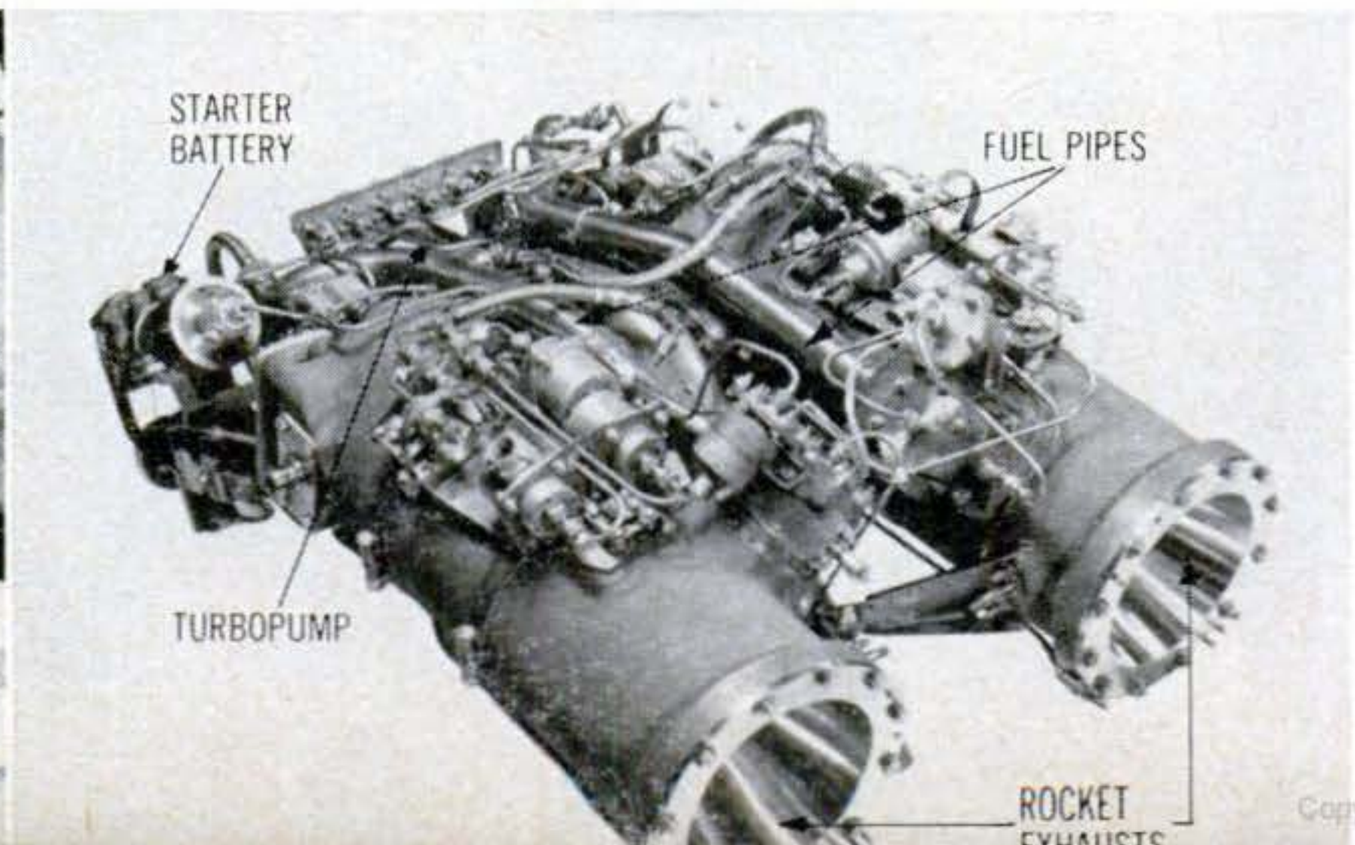
Terminal handles 30 express cars, 53 trucks at once

POWER and gravity belts, rollers and moving slats—1,213 feet of them, in all—move 600,000 pieces of express a month at this new Railway Express terminal, across from the New York skyline at Hoboken. In the lower photo, packages are processed simultaneously from trucks and trains. The loading facilities can accommodate 53 trucks and 30 cars.

Twin rocket booster sends bomber to altitude record

A NAPIER Double Scorpion rocket, slung under the fuselage below, enabled a British Canberra to set the bomber altitude record at 70,000 feet. The twin booster, using high-test peroxide to ignite the fuel, can be started and stopped at will. Aerojet General will make it in the U. S.





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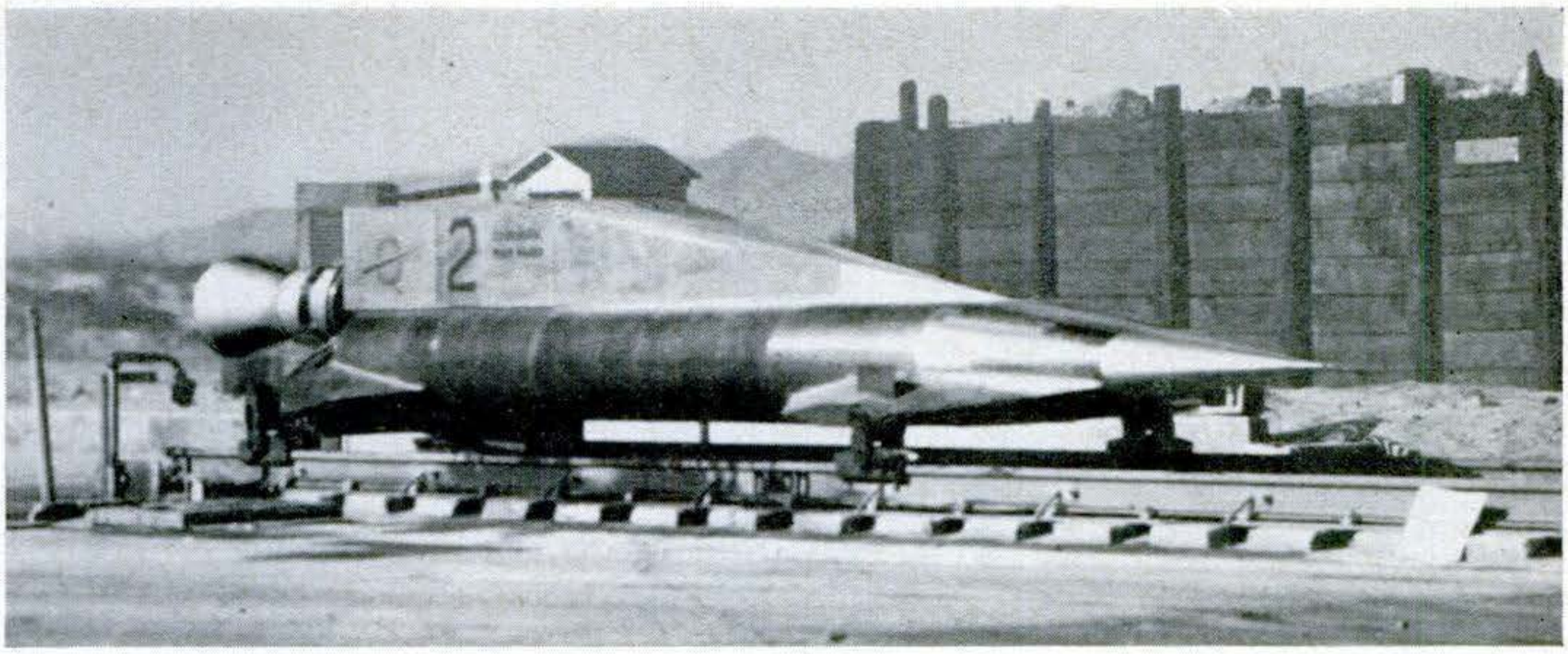
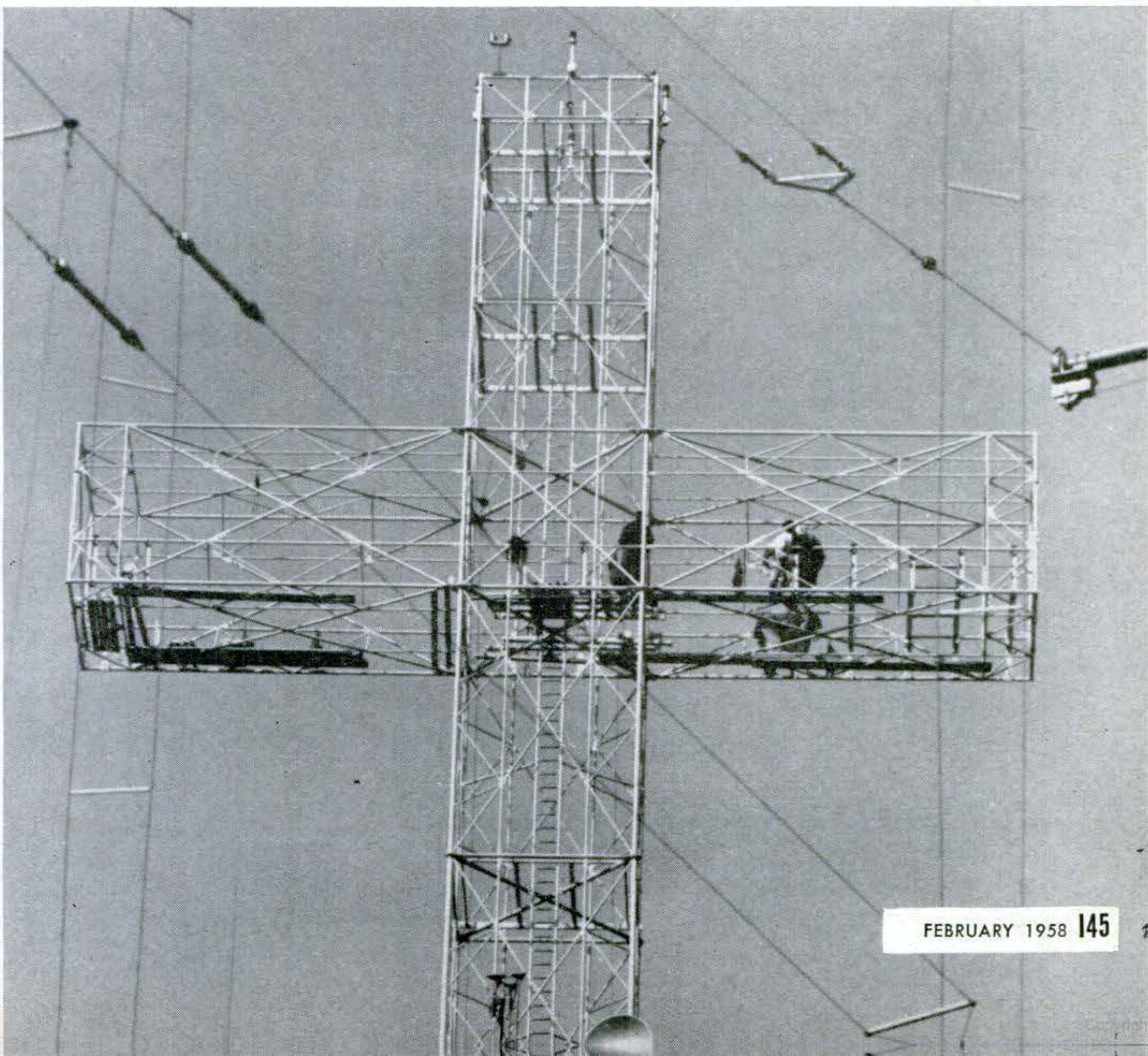


Fastest supersonic sled moves 1,500 feet per second

RIDING the world's fastest railway, this new rocket sled at Edwards Air Force Base in California is designed to travel at 1,050 m.p.h. to test aircraft components at supersonic speeds. Its Rocketdyne engine develops 50,000 pounds of thrust, runs on liquid oxygen (LOX) and alcohol.

Tower of new Vatican radio is shaped like a cross

THIS symbolically cross-shaped tower dominating the powerful new radio station operated by the Vatican will transmit the voice of the Pope to any part of the world. The antenna installation is at Santa Maria di Galeria, 11 miles north of Rome. Broadcasts are made in 40 languages.



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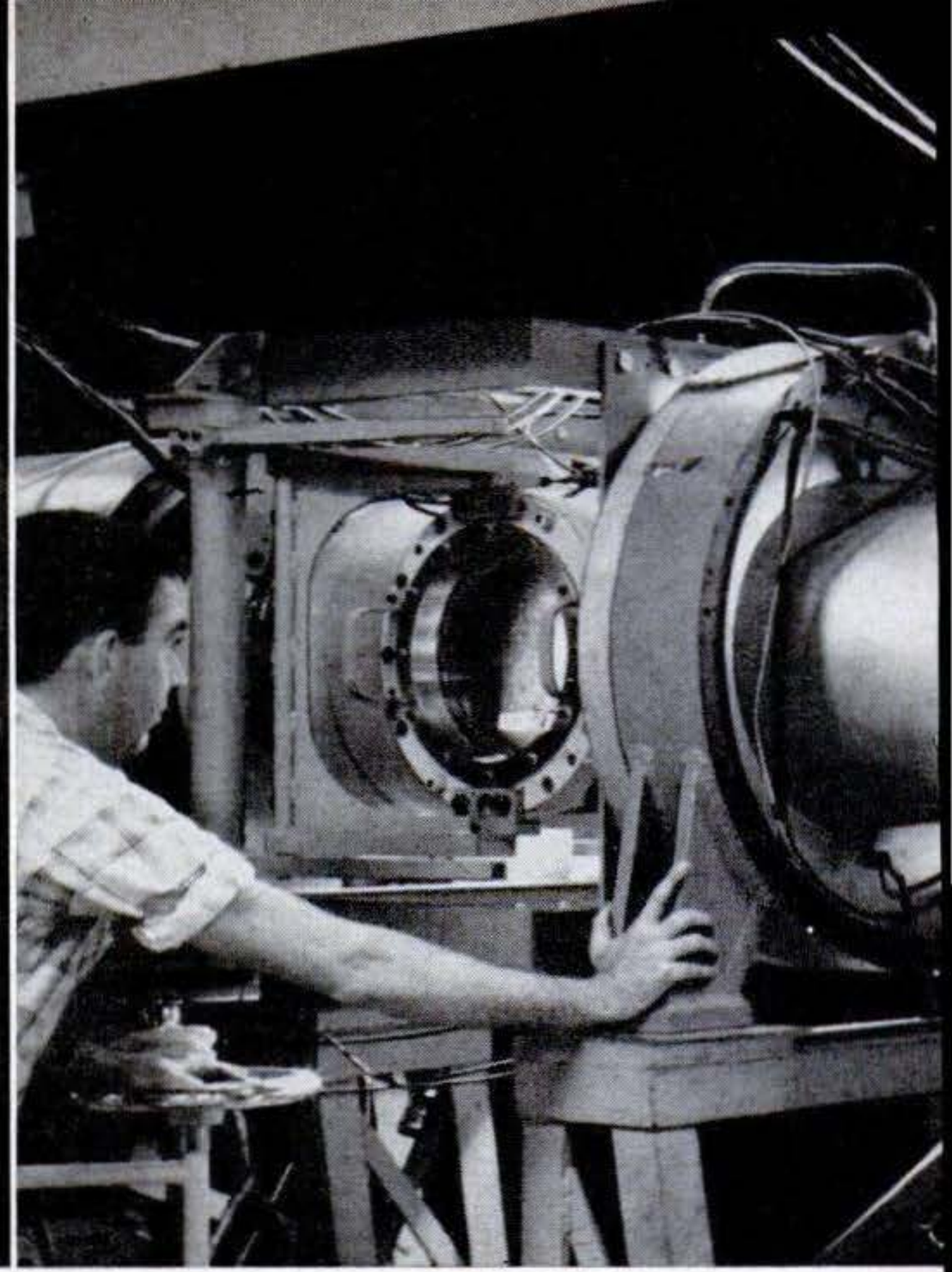
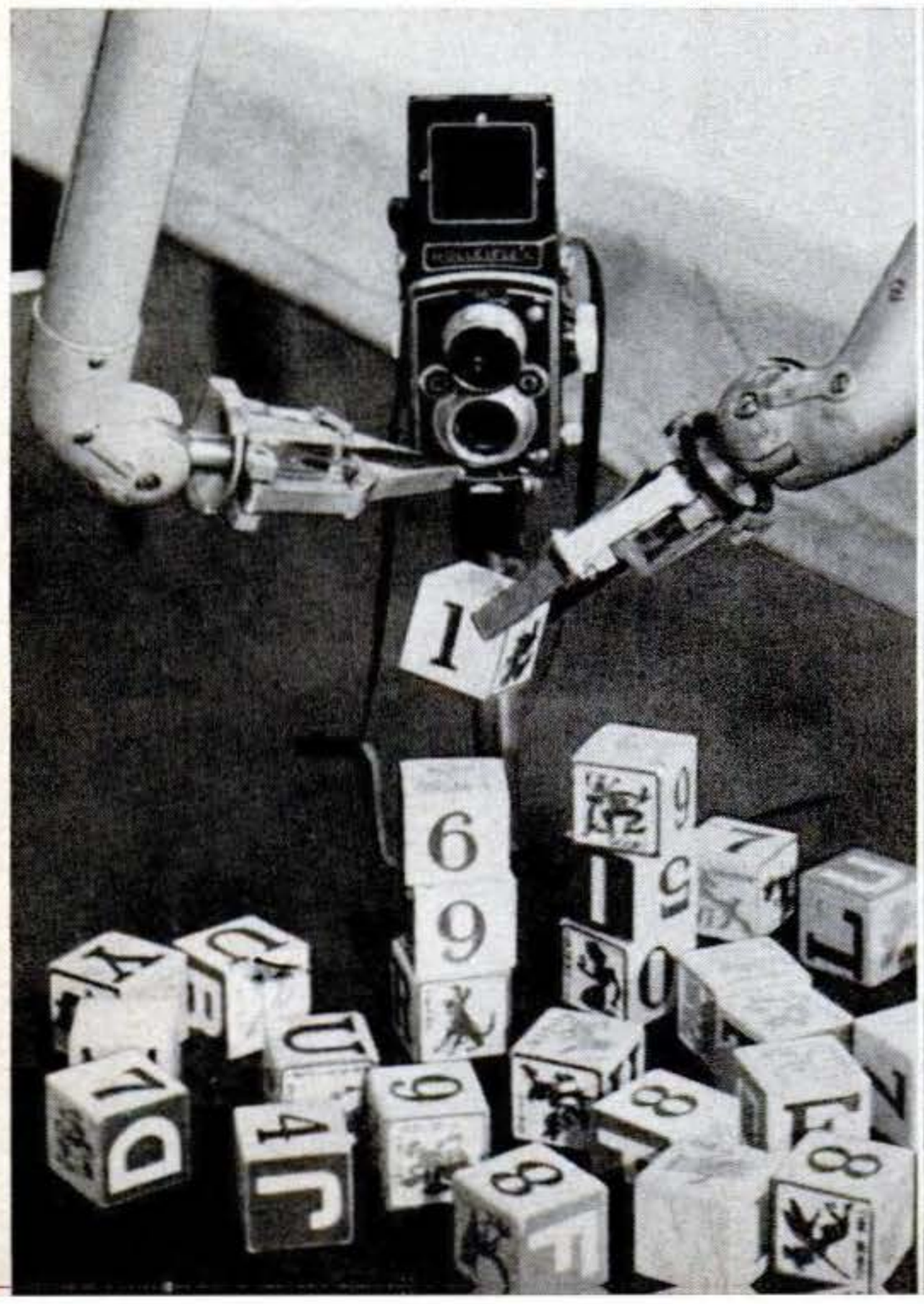


Incandescent air takes a shock picture of itself

ILLUMINATION for the photograph above, taken through a window (left) in the "Hotshot" wind tunnel at right, was provided by the air itself flowing over a cutaway cylinder at some 16 times the speed of sound. At this far-hypersonic speed, the air developed a pressure of 20,000

Mechanical arm photographs its twin in action

A PAIR of electro-mechanical manipulators, designed for remote control of radioactive substances, demonstrate their flexibility below at the Atomic Trade Fair in New York. At left, one of the "hands" operates a camera. At right is the picture it took of the other hand stacking blocks.



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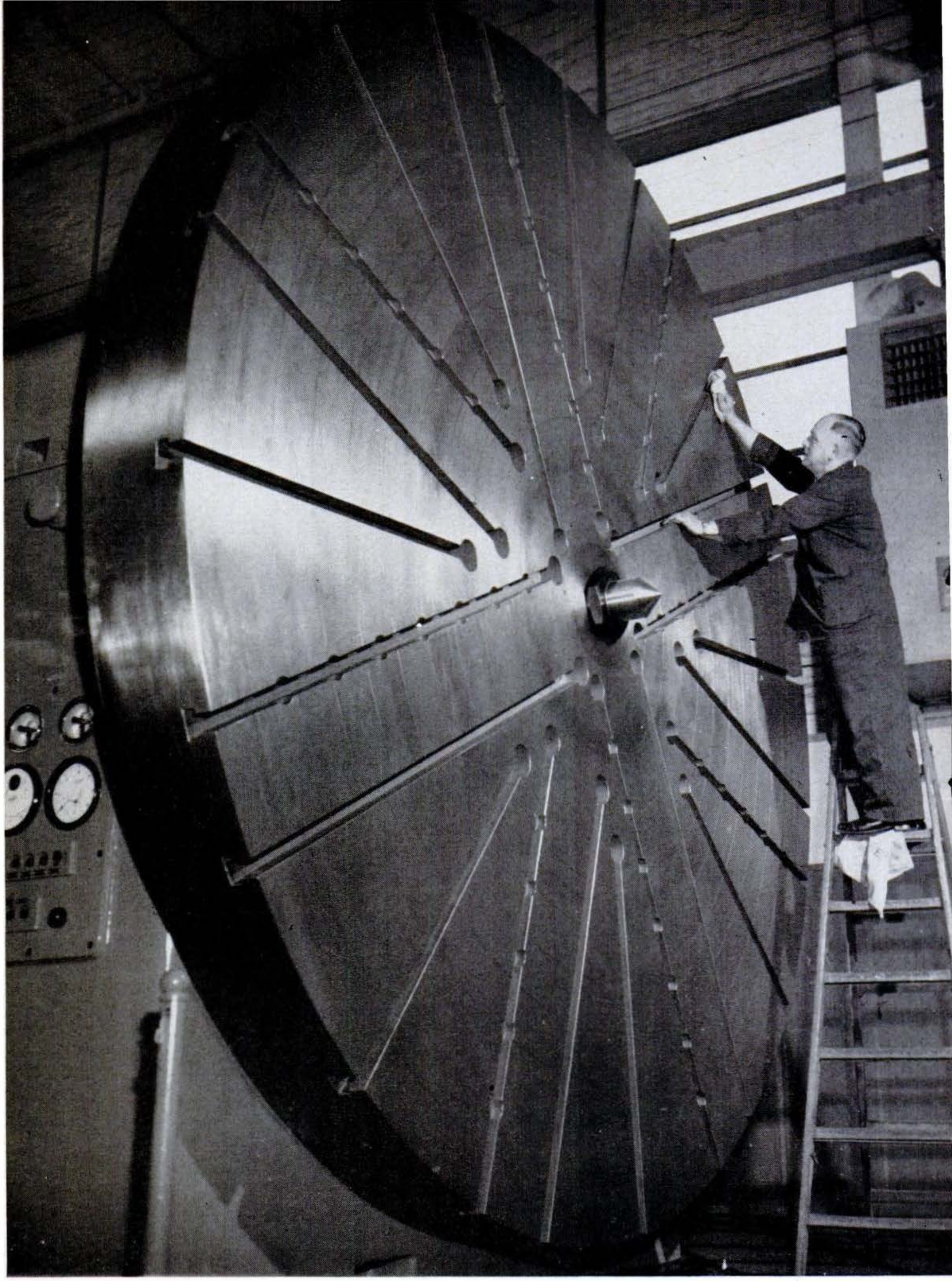
pounds per square inch and attained the incandescent temperature of 10,800 degrees to simulate conditions missile materials will meet on reentering the earth's atmosphere. The picture was taken during test runs lasting from 1/100 to 1/25 of a second. The tunnel is part of the gas dynamics facility at the Air Force development center at Tullahoma, Tenn.

Electric heating elements de-ice British road

To THAW sudden ice deposits on highways, the British Director of Road Research is trying two kinds of electric heat. Here a 100-foot section is laid with heating cables carrying a 240-volt charge under the road surface. Another strip uses a grid taking 30 volts from a transformer.



Gigantic faceplate made for 16-ton lathe

THIS faceplate for a 16-ton lathe measures almost 14 feet across. It's shown here being cleaned at the European engine-tool exhibit at Hannover, West Germany. The lathe will be shipped to India where it will be used to help make parts for industrial machine tools.

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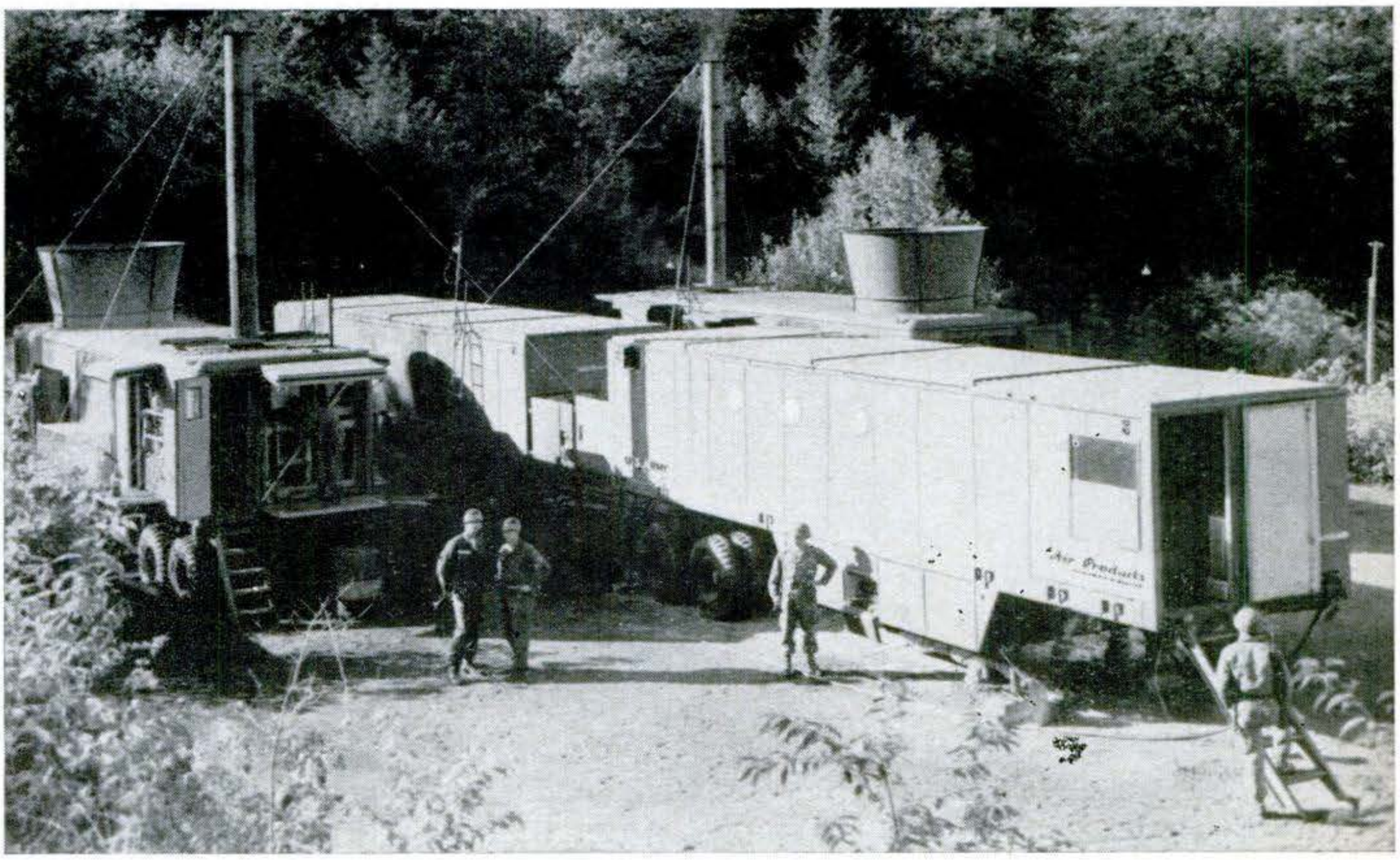
Watertight hull makes helicopter amphibious

A REINFORCED and fiberglassed hull bottom, plus outrigger floats, adapt this Navy HUP-2 helicopter to water as well as land. The amphibious copter was converted by Edo Corp. of College Point, N.Y., for use in carrier-escort and anti-sub warfare, and for over-water ferrying.



Rolling Army plant produces LOX from thin air

BATTLE-LINE production of liquid oxygen for guided missiles is possible with the Army's new plant on wheels. The three trailer units above, built by Air Products, Inc., liquefy oxygen from air with diesel-run compressors. The plant will make 20 tons of LOX in a 24-hour day.

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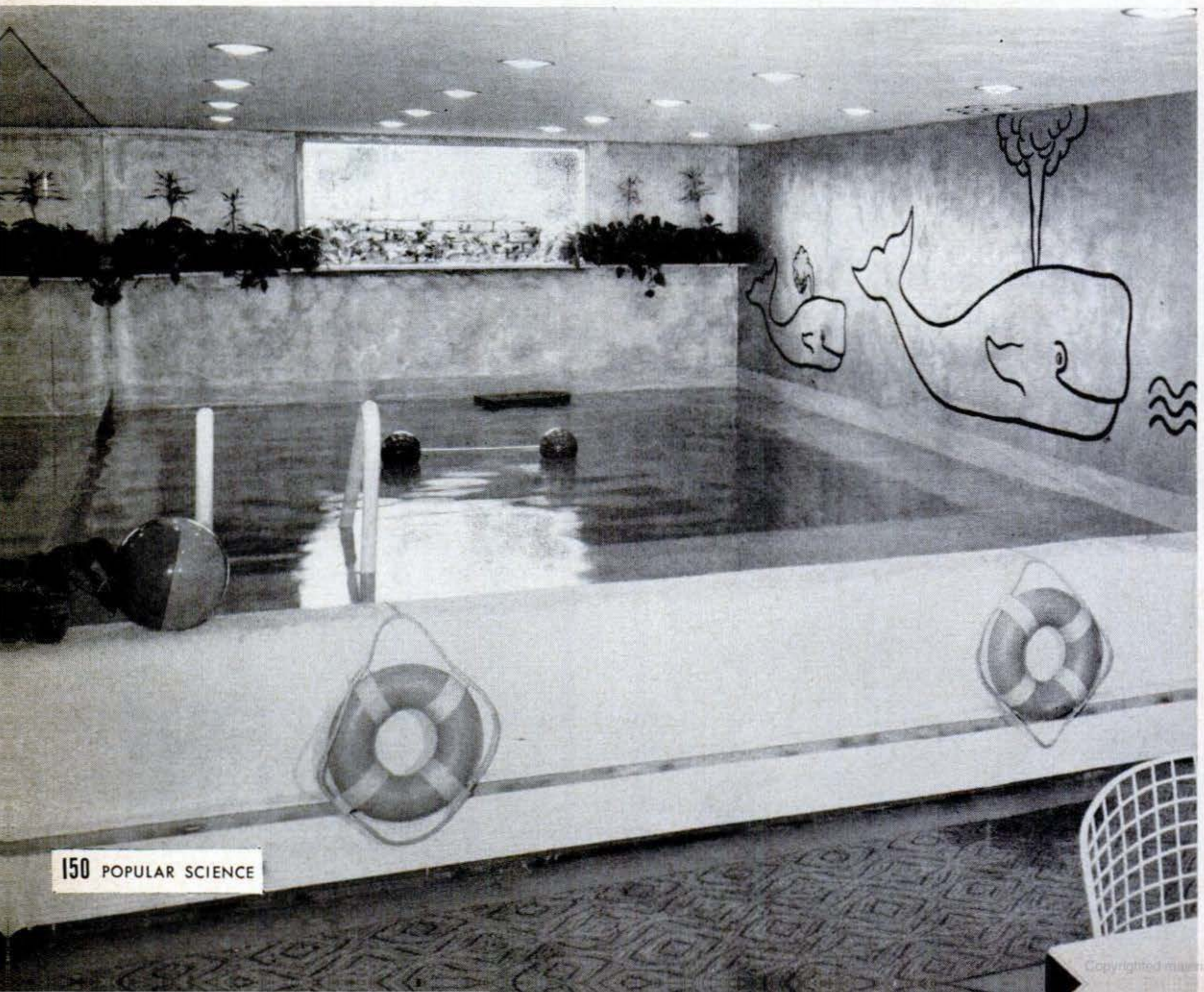
Camera takes swivel-neck view inside new Chrysler

Here's what you'd see from the driver's seat of a new Chrysler—if you could swing your neck around like a movie-cartoon ostrich. Distortion in this photo—taken by a special camera with rotating

Development home comes with basement pool

Now you can buy a house with a built-in basement swimming pool. Eden Roc Homes in Smithtown, N.Y., has them with the swimming pool optional: $20,000 to $25,000 without, $800 or more extra with the pool. Features include a mirror wall, picture window, 22 ceiling sun lamps.



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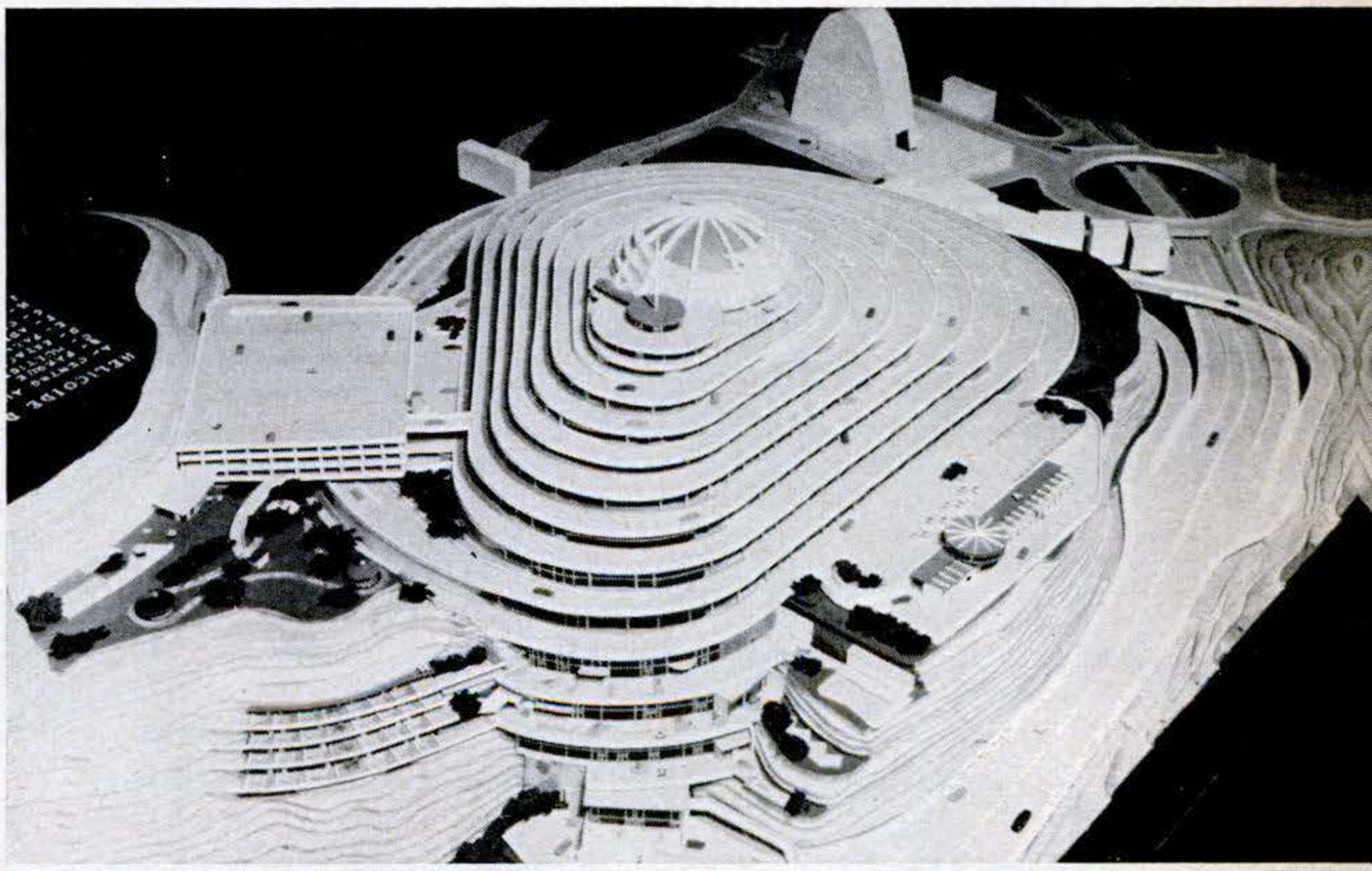
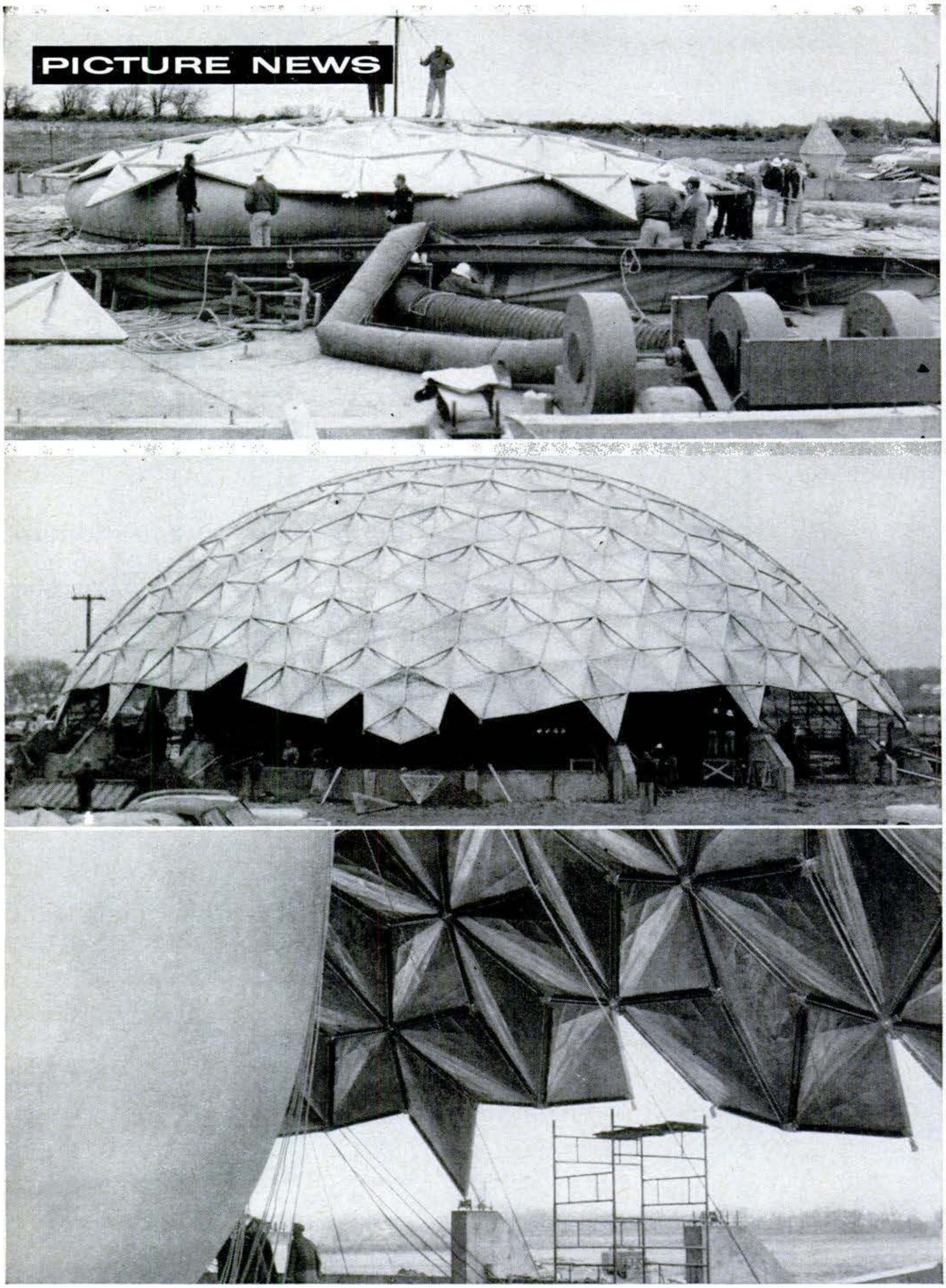
gear—is minimized if you curve the magazine into a semicircle and hold it close to your eyes. The scenery shown here, from left to right: Windsor, Canada; Detroit across Detroit River (windshield); MacArthur Bridge (right window); Belle Isle (rear); and back to Windsor.

Spiral-pyramid business center is carved in mountain

On a 365-foot mountain overlooking Caracas, Venezuela, a "helicoid" business center is now underway (shown below in model and in making). It will provide showrooms, offices, garages, hotel, swimming pool and 320 stores, all reached by spiral ramp. Jorge Romero Gutierrez designed it.





This factory went up fast—it's built on balloons

THIS aluminum-dome factory, the first to be constructed on balloons, was built at Abilene, Kan., by 28 men in 22 hours. Two nylon balloons, one atop the other on a 145-foot concrete slab, were blown up one at a time, and Kaiser diamond-shaped panels were assembled on them as the balloons were filled. The factory, 50 feet high, will make conveyors.

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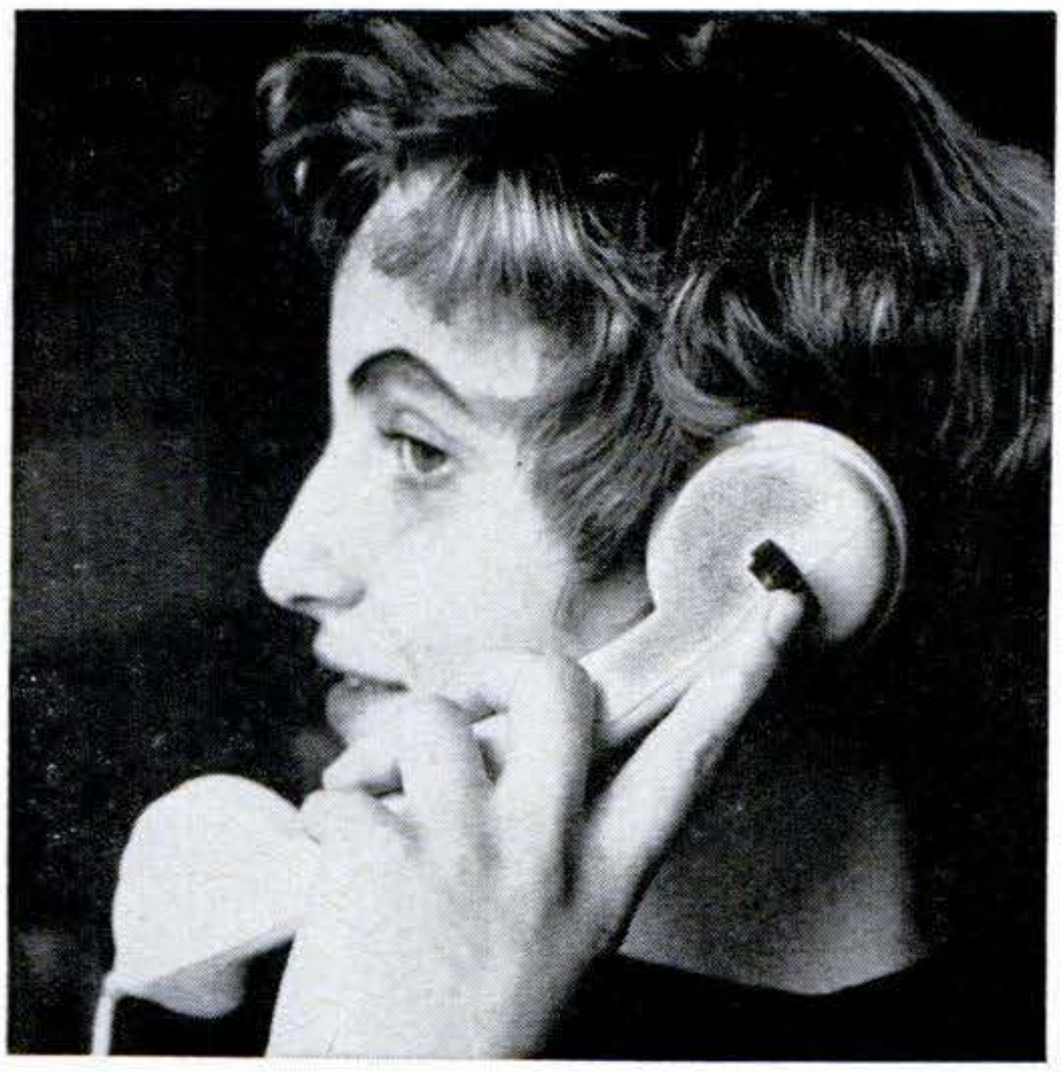


She controls phone's volume

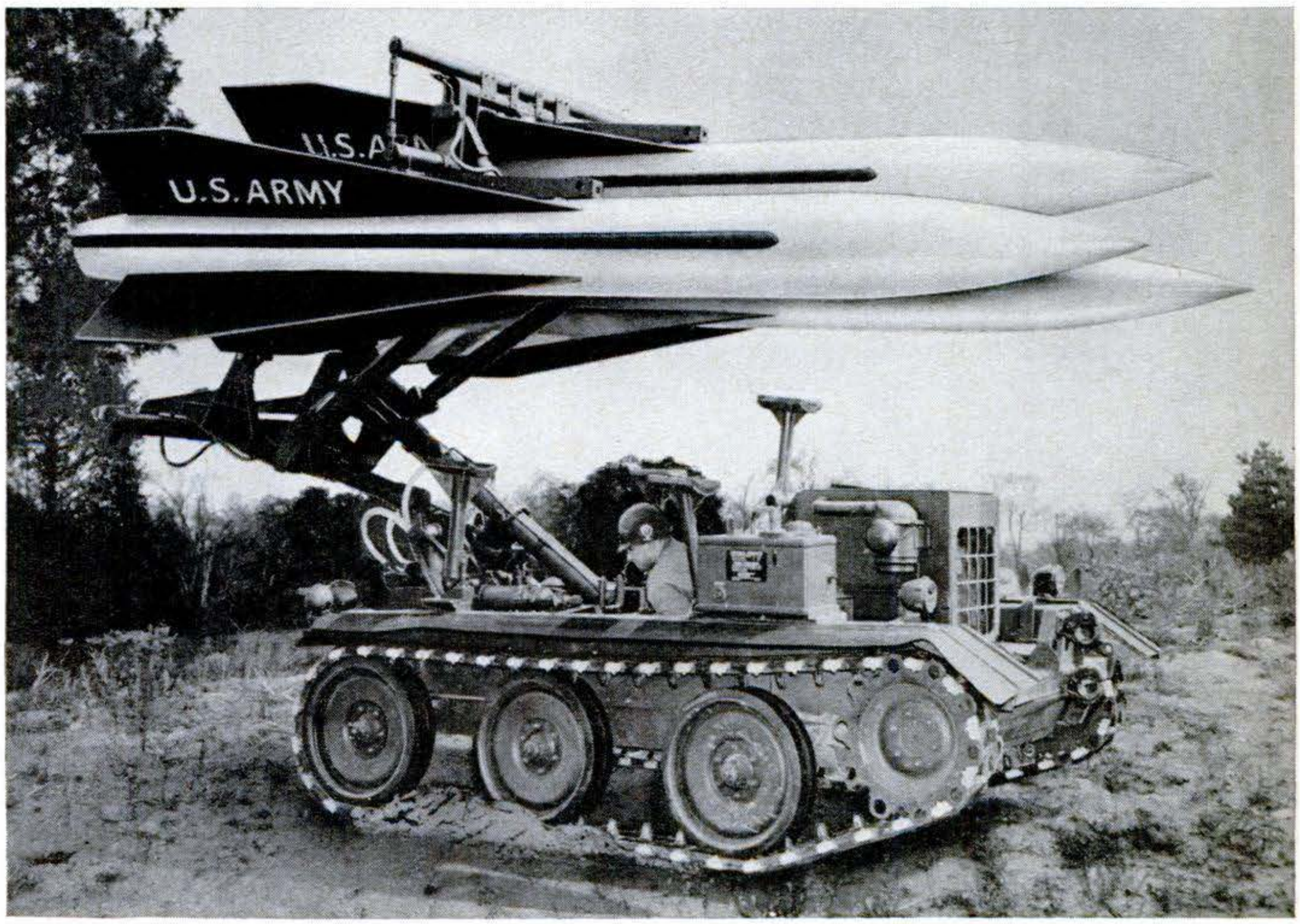
A KNURLED knob within finger reach on the new German telephone receiver above controls a small amplifier. The listener can turn volume at his end up or down.

Seat takes jolt out of jeep

THIS canvas seat on an aluminum frame has rubber springs and drawstring adjustment for easy riding. Bostrom Mfg. Co., Milwaukee, makes it for Detroit Arsenal.

Triple loader rushes Hawk missiles to firing line

THE tractor-driven missile loader below is the Army's newest method of transferring deadly Hawk ground-to-air rockets quickly from storage to launcher. Self-propelled and highly maneuverable, the loader travels equally well over muddy or rough ground. Each will carry three "birds."



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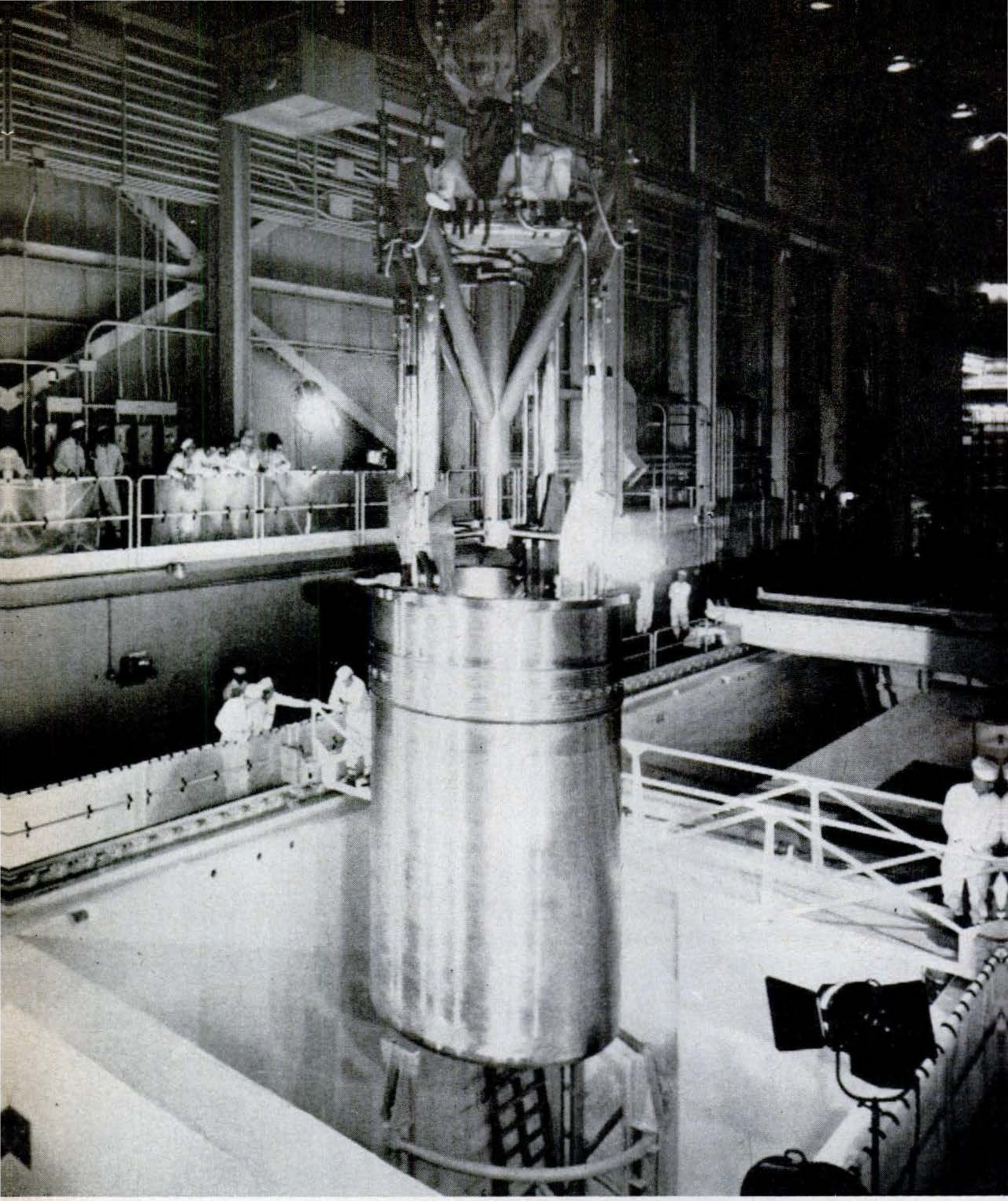

First full-scale atomic power plant gets nuclear fuel

HERE the nuclear core of the nation's first full-scale atomic power plant is lowered into position at the Duquesne Light Co.'s electric power plant at Shippingport, Pa. The big cylinder contains 14 tons of natural uranium and an additional 165 pounds of highly enriched uranium. All technicians engaged in the project are garbed in surgically clean clothing.

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He boils electrons out of metal to turn heat into electricity

THIS "thermionic converter" makes electricity from heat in a new way, and gets eight percent of work from applied heat—compared with a thermocouple's one-percent return. GE physicist Volney C. Wilson, shown with the device above, expects to get up to 30 percent and to electrify more than the bulb at right.

Electrons are boiled out of a white-hot metal electrode and sent through an ionized tube to a cold electrode, producing current. The principle may lead to major new sources of electricity—from sunlight or from the heat of nuclear fission.

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Biggest Boom

Electronic organs—easiest to play of all major instruments—are

By Robert Gorman

TO CELEBRATE his 79th birthday, a retired railroad man in Wichita, Kan., treated himself to an electronic organ. A few weeks later, though he had never played an instrument before, he was giving recitals for friends.

"I had so much time on my hands that I kind of wore out my other hobbies," he explained. "So I took up a new one."

With minor variations, this is the theme song of a new march of music that has no parallel in the history of sound. The zooming popularity of electronic organs is partly measured by a more than sixfold sales increase in four years—from 16,000 units in 1953 to an estimated 100,000 last year.

The oddest thing about the boom is that—by traditional standards—most organs are bought by the "wrong" people. That is, the majority of purchasers are older folks with little or no musical background.

This is in contrast to the long-term pattern of keyboard sales. Trade analysts point out, for example, that eight out of 10 pianos are bought either for children or for adults with previous training.

Who plays? Recent surveys have filled in a few other details about the new organists. Their average age is about 40, and women slightly outnumber men. When an organ comes into the home, more than half the family members learn to play. Most organs are bought for immediate fun rather than long-range cultural education. Though organ prices average over a thousand dollars, more than two-thirds of all purchasers have family incomes under $7,000. Skilled workers, the largest single group, are followed closely in organ ownership by white-collar, business, and professional people. Tens of thousands of owners have banded together in clubs that combine sociability with mutual instruction and, very often, community service.

From even this sketchy data it is easy to see the outstanding appeal of the modern electronic organ: It brings the pleasure of musical creation to people who missed the opportunity of mastering other instruments.

How and why have these various assemblies of motors, gears, vibrators and vacuum tubes been able to move in on what was once the most specialized of musical specialties? There are many contributing reasons, but the main push has undoubtedly come from the nature of the organ itself. Of all major instruments, it is the easiest to play.

That doesn't mean there aren't great variations in skill and artistry, but rather that the worst duffer can quickly learn to produce pleasant, *listenable* music.

Unlike pianos, whose tones tinkle briefly and die away, organs will sustain a sound as long as you press the key. So even when you pick out a tune note by note, the melody ripples smoothly along.

Playing an electronic organ is made easier by another characteristic that distinguishes it from other keyboard instruments: The ivories are electric switches, not levers controlling hammers or picks. That means the sound isn't affected by uneven fingering. You don't have to vary your touch to add expression to music; you merely adjust a volume control with your knee or foot.

These easy-play advantages are common to most electronic organs. Manufacturers and music publishers have made the most of them by devising various kinds of "picture music," "pointer systems," and other learn-at-home scores. One company proudly advertises to organ dealers that its home-instruction course is "not approved by old die-hard music teachers." It is designed, boasts the ad, "to sell the prospect, not make a musician out of him."

A giant step toward play-it-yourself music for everybody was taken a few years ago when the Hammond Organ Company—first and still largest in the industry—introduced the first chord organ. More recently, chord organs have

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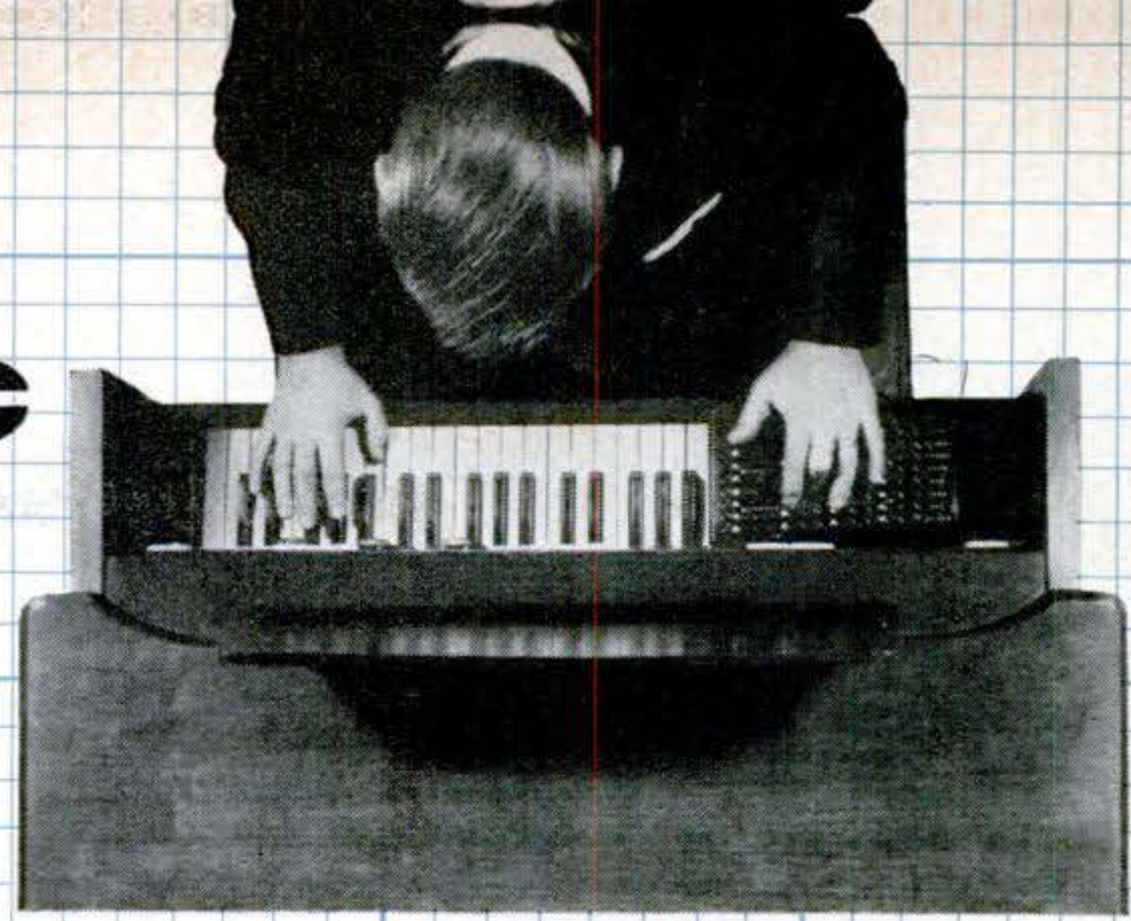
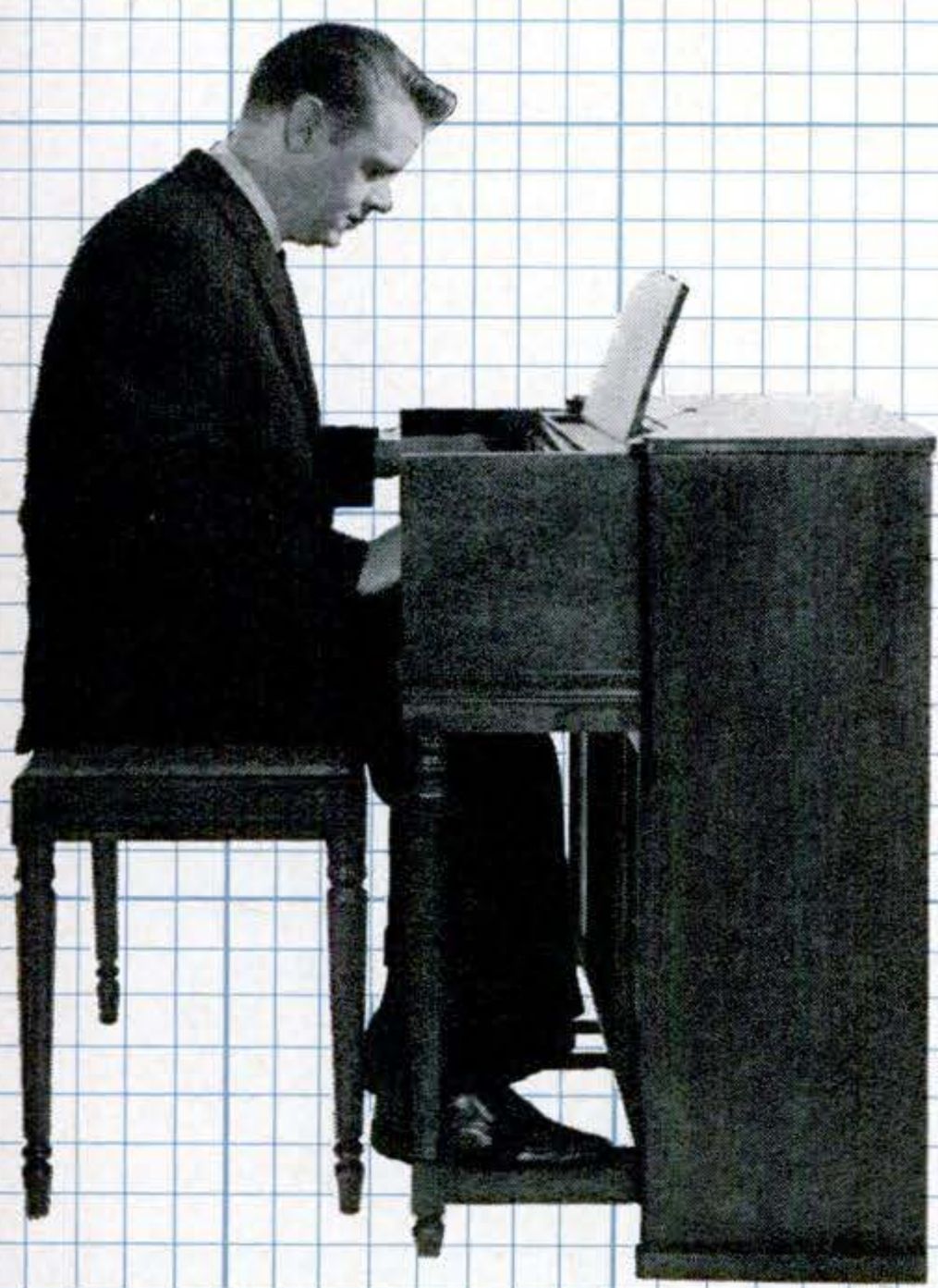
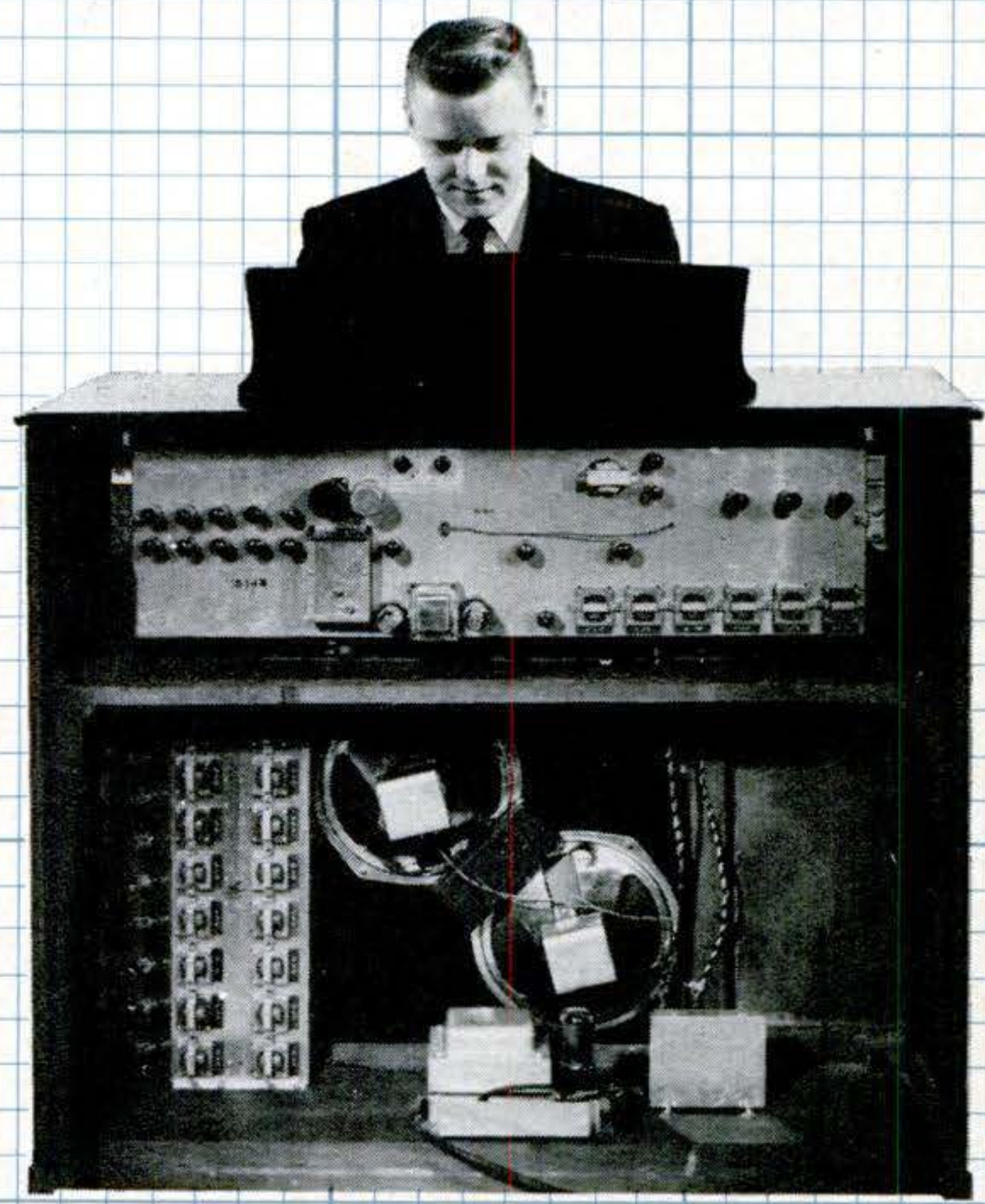
in Music

zooming in popularity







also been brought out by Wurlitzer and Thomas.

As its name suggests, this trim, low-priced newcomer makes the playing of chords all but automatic. To sound the three or four notes of a chord, you have only to press a clearly marked button with one finger of your left hand. This combination of one-finger chords, and the sustained organ tone that lets you pick out a flowing melody with one finger of the right hand, shatters the last barrier between buying an instrument and learning to play it.

In organ language, the "musical resources" of chord organs are relatively limited. They have fewer "voices" than other models, and less range within each voice. But for most players, the things they don't have will never be missed. Thousands of sparkling chord-organ performances by concert and recording artists give evidence of their musical range.

The abundant variety possible in these babies of the organ world is indicative of the range of the larger, non-chord models: On most of them there is no practical limit to the musical sounds and special effects you can produce.

What kind of instruments are organs? How do they work? A dozen manufacturers now offer several times that number of models. These differ from each other in size, power, tone quality, and versatility as well as in their operating principles.

Electric or electronic? In order to dis-

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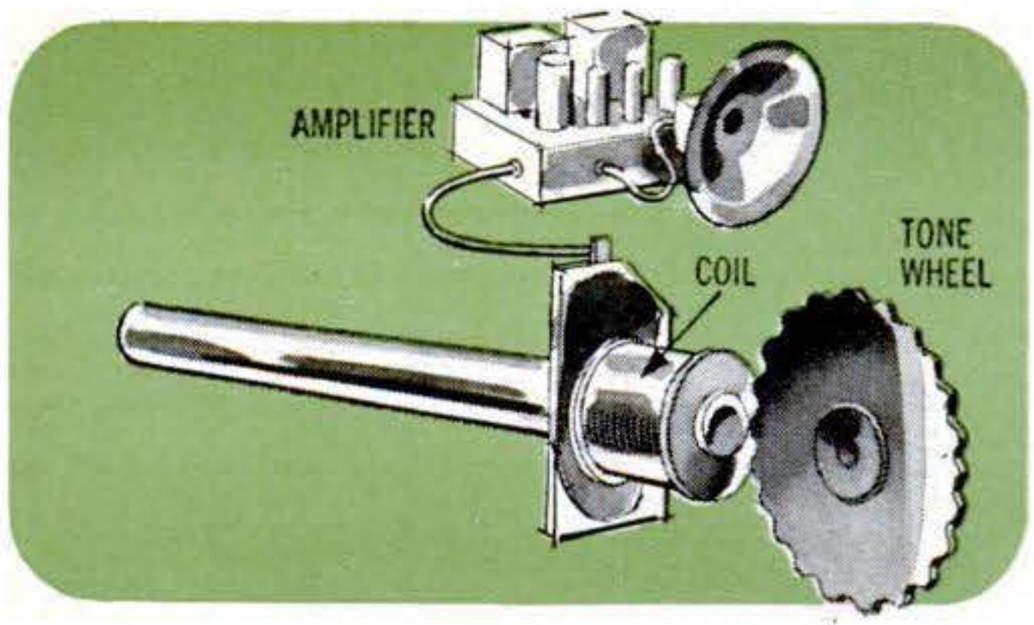
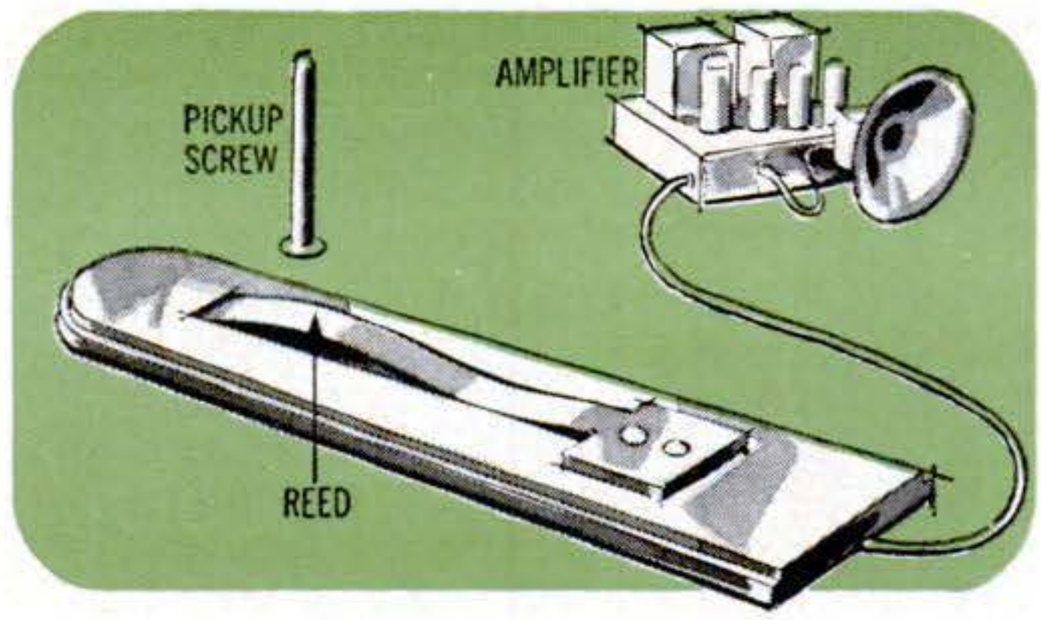
How they get their sound: These four types



ELECTROMAGNETIC



ELECTROSTATIC

STEEL disks—or tone wheels—are the basic mechanism of all non-chord Hammonds. Motor-driven at a constant speed, each disk rotates in front of an electromagnet and induces a current in the magnet's coil. The frequency of the induced current is determined by the number of high and low spots on the rim of the disk, and each tone wheel is carefully machined to put out a pure fundamental, or sine wave. Standard models have 91 disks—61 tuned to the notes of a five-octave keyboard, plus 30 pedal and harmonic tones. All disks are constantly in motion, and thus constantly generating their fixed frequencies.

Voicing, or tone coloration, is controlled by Hammond's unique "drawbars." These are nine slide switches that mix the fundamental and eight harmonically related frequencies, and adjust the signal intensity of each. Since each drawbar has eight position settings, any note on the keyboard can be colored in thousands of different ways. Pressing a key sends its tone-colored note to phono-type amplifier and loudspeakers.

THE vibrating reeds that generate tones in standard Wurlitzers are similar to those in older reed organs. However, a blower keeps all reeds vibrating all the time, and thus eliminates the time lag characteristic of individually blown reeds. Also, these brass reeds are enclosed in boxes to muffle their hum. What you hear are amplified signals, not the reeds themselves.

Each of the 73 brass reeds in the six-octave system is cut for the specific resonant frequency at which it will tend to vibrate once it is set in motion by the fan. Pickup screws are mounted near the free end of each reed. When small DC voltages are applied to a reed and pickup, they become, in effect, the plates of a variable condenser whose capacity changes at a rate corresponding to the reed's frequency. This produces an alternating voltage of the same pitch.

The voice or coloring of a note is affected by the type of pickup (which is why some reeds have more than one); in addition, "stop-tablet" switches on the console provide combinations of harmonics.

cuss the basic types, it is useful to distinguish between the two. Actually, both are electronic since both use vacuum-tube amplifiers to boost tone signals so they can be heard through loudspeakers. For greater clarity, however, the term electronic organ is often reserved for those models that use vacuum-tube (or transistor) circuits not only to amplify signals, but also to generate them. This category includes all chord organs and all but three of the many non-chord varieties.

The three electric—or, if you prefer, electromechanical—organs use distinctly different systems of tone generation (see diagrams above). The famous Hammond organ produces sounds electromagnetically; Wurlitzer's so-called reed organ is actually electrostatic. The third, or photoelectric, system illustrated should be available shortly in the new Kimball organ.

Whether they work mechanically, electrically or electronically, organ generators produce signal voltages. Each signal—selected by a key or pedal switch—corresponds in frequency to a particular note. Frequency, or pitch, is the characteristic that determines the place of any sound in the musical scale. Thus if a plucked string sets up air waves that vibrate at a frequency of 262 cycles a second, you call the resulting sound middle C; a 622-cycle wave is D-sharp in the octave above. Every note has its own frequency. It is the same whether that note be played on a piano or a flute.

Yet obviously a piano note sounds different from the same one played on a

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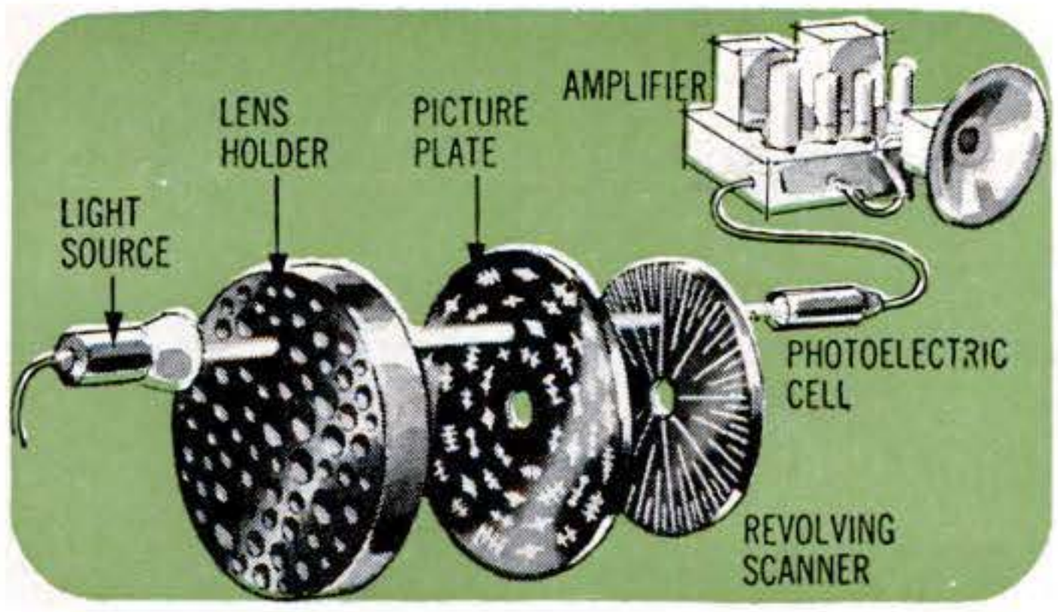
of generators create most organ tones



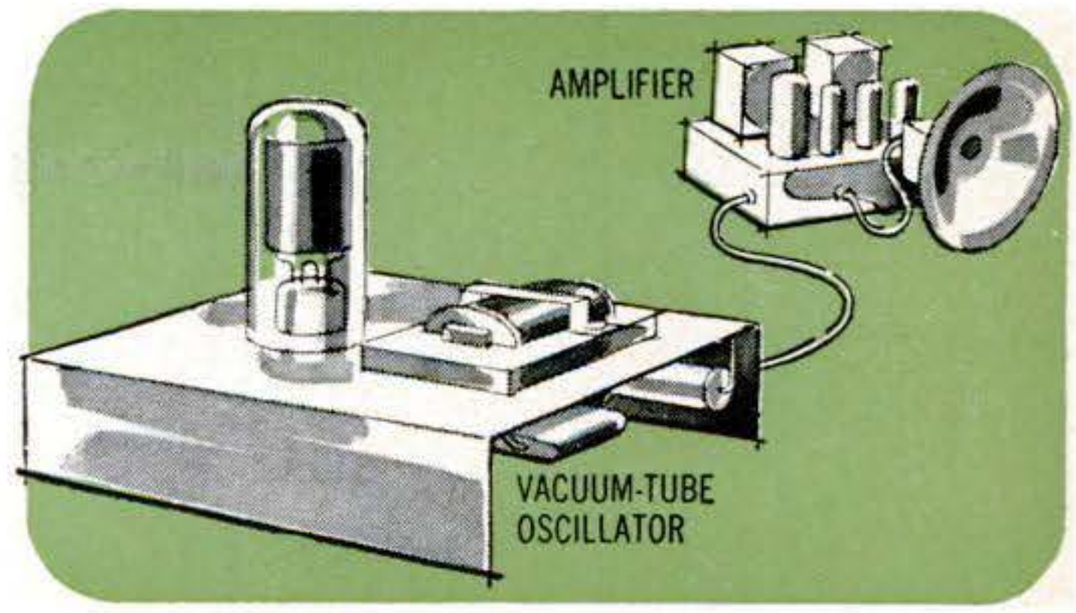
PHOTOELECTRIC

THE optical sound track on movie film is a close cousin of the photoelectric tone generator in the new Kimball organ. Standard models will have 12 generators, each providing a different voice.

A "picture plate" in each unit has outlines of five octaves, or 61 separate notes. When a key is pressed, a selected light shines through the appropriate "tone picture," and a lens focuses it on a revolving scanner. The scanner analyzes the beam and relays its distinctive characteristics to a photocell that then converts the light into a signal voltage.

A claimed advantage of this system is that it generates completely voiced organ notes—not clusters of fundamentals and harmonics that must then be combined by other circuits. And the tone pictures are said to be the exact copies (in optical recordings) of real organ sounds.

For a custom installation, it actually would be possible to "photograph" the notes of any of the world's great organs, then make up a composite instrument containing a dozen or more selected voices of your choice.



ELECTRONIC

VACUUM-TUBE (or transistor) oscillators furnish the signals that make sounds in all chord organs as well as in standard units made by Allen, Baldwin, Conn, Estey, Lowrey, Thomas and others.

Individually, electronic oscillators are simple circuits—Morse-code-practicing youngsters have been building them for several generations. But an electronic organ has several rows—or several dozen rows—of them, each designed to squeal at a selected frequency.

Design differences among electronic organs are partly reflected by an enormous price range, running from about $700 for the simplest home model to $30,000 or more for some auditorium installations. There are also many technical differences among organs of comparable price.

Some designers, for example, prefer to create pure sine waves, then synthesize instrument voices by combining fundamentals and harmonics. Others design organs to generate signals rich in harmonics, then filter out the ones that aren't wanted.

flute. The difference is that a flute speaks in a fairly "pure" voice while string sounds are rich in harmonics. These harmonics, or overtones, are related-frequency vibrations—that is, fractions or multiples—that blend with the fundamental frequency to form the total sound.

Every instrument has a distinctive pattern of resonant frequencies (called a "formant") that gives it its unique voice. Since an organ imitates many different instruments, it must have some means of recreating the proper formant of each one. This can be done in several ways.

In some organs individual generators put out pure tones which are then combined in varying proportions to simulate a desired resonant pattern. Others start by generating complex, harmonic-rich waves, then pass them through filters that emphasize some harmonics and diminish others. The variety of voices available in any organ depends partly on the type of combining circuits employed, and partly on the number of independent tone generators. For all practical purposes, however, electric and electronic systems can simulate any "authentic" organ voice—and quite a few others.

What are these voices? How and why are they chosen? Most of them derive, by a roundabout path, from thousand-year-old pipe-organ traditions.

Essentially, a pipe organ consists of a bellows (or wind chest), a set of pipes, and an assortment of slides and levers that open and close gates between the

[Continued on page 244]

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The fastest man alive describes his sensations while setting the world's speed record in a rocket plane:

I Flew 1,900

Early in the morning of Monday, July 23, 1956, Lt. Col. Frank K. Everest Jr. (left) climbed into the cockpit of a Bell X-2 rocket plane. His goal: a speed never before attained by man—three times that of sound. This story of Everest's epoch-making flight, from takeoff to landing, is from his book "The Fastest Man Alive," to be published later this month by E. P. Dutton & Co., New York.

By Lt. Col. Frank K. Everest Jr. as told to John Guenther

THE purpose of the ninth powered flight of the Bell X-2 rocket plane was to expand the speed/altitude envelope to a point approaching Mach 3. This would be faster than man had ever flown before. We were shooting for three times the speed of sound, which is nearly 2,300 miles an hour at sea level. Of course, my true air speed would not be that high where I was flying, as the speed of sound decreases with altitude.

I was well aware of what I was getting into. Before this flight, as on previous tests, I had flown the GEDA machine, a Goodyear electronic digital analyzer, which could predict actual flight conditions based on the information we gave it. We had fed in the various stability parameters at anticipated Mach numbers, and had noted that under certain conditions the airplane would "uncork" and go out of control.

For example, if I pulsed the ailerons too much—moved them too far—at the higher Mach numbers, the X-2 would become uncontrollable. Or if I made too tight a turn at high speeds, GEDA would show me going out of control. The high-speed flight station at Edwards Air Force Base, which furnished us much of the advice and guidance on X-2 instrumentation, had extrapolated previous flight data and forecast the stability limits of the airplane. They told me frankly what the dangers were on future flights. I followed directions and that is why I am here today.

Preparation for the flight began on Sunday. The water alcohol was cooled to zero degrees Fahrenheit in order to condense it and get the maximum fuel load on board. The Bell ground crew and technicians completed preflight inspection of the aircraft and engine, after which NACA personnel installed high-speed flight instrumentation and established zeroes. New batteries were installed and then the X-2 was mated to its B-50 mother ship in preparation for a dawn takeoff the following morning.

Instrumentation included pressure pickups for the rocket chambers, the fuel and LOX tanks, the intake and exit ports of the gas generator, and the intake and exhaust for the turbine pump. Strain-gauge pickups were installed on the rudder, ailerons and stabilizer to measure the forces that I would apply to these control surfaces. We also installed position pickups on the control stick, rudder and control surfaces to determine the position of all controls and their surfaces at all times during the flight.

A yaw meter would measure the degree of yaw of the airplane in flight. Another instrument measured the angle of attack. Roll-and-bank and acceleration instruments gave us a record of acceleration in all directions—fore and aft, lateral and longitudinal. The X-2 also carried a radio transmitter that I would use to report my progress verbally.

Because I expected to run into high-speed heating on this flight, we had installed surface-temperature pickup gauges

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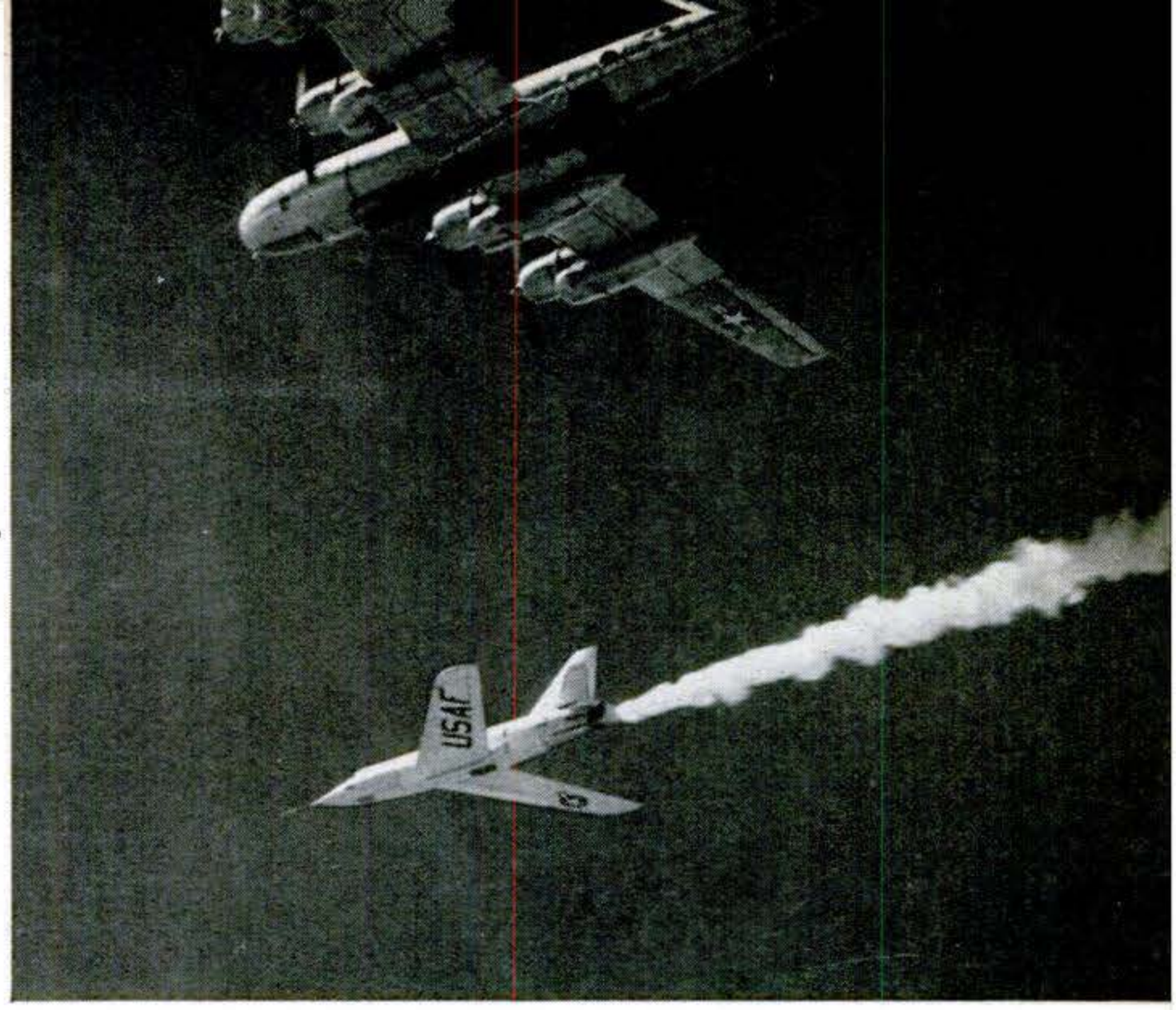
M. P. H.



DROPPED FROM B-50 BOMBER at 30,000 feet, the X-2 falls free, streaming fiery vapor from its twin-chambered rocket engine. The X-2 holds two world's records for piloted aircraft: speed and altitude.

to measure the air-friction temperatures. We had also painted the airplane with stripes of heat-resistant paint. They were of various bright colors, each color designed to withstand a specific temperature before it melted, and the nose and leading edges of the X-2 looked like a rainbow. As each color melted and started to run, we could estimate the approximate temperature encountered on that part of the airplane.

A radar homing beacon was installed to enable the NACA-calibrated radar station at the main base to follow my flight. Both NACA and Air Force radar would track me, giving my speed and altitude as a check against my flight instruments.

At four a.m. on the flight line at South Base Monday morning, Jimmy Dunn, the X-2 crew chief, signaled his ground crew to begin pumping six tons of water alcohol and liquid oxygen into the waiting rocket ship. Working in predawn darkness, the sleepy men moved silently about the airplane, making it ready for another assault against space.

It was five a.m. when the alarm clock roused me from my sleep. The first light of morning was creeping above the eastern desert, and looking out the window to check the weather, I saw with concern that the sky was overcast. The X-2 did not have all-weather capabilities, and I could not attempt a deadstick landing through clouds. I had built myself up mentally in preparation for this flight and did not relish canceling it.

I immediately telephoned the weather officer at the base for a prediction of cloud cover at takeoff time. He forecast three- to four-tenths cover at seven a.m., which would not be a problem.

For breakfast I had an eggnog and a piece of toast. I was not hungry and couldn't eat more. After breakfast I went in to see the children but they were still asleep. Avis came out on the porch with me and I kissed her goodbye. "Wish me luck," I said. She was under the same pressure I was, and both of us were a little tense. She clung to me a moment, then straightened up, smiling. "I wish you all the luck and love in the world," she said.

I drove to the flight line to check on the airplane, then continued to my office to dress for the flight. The other pilots were already there waiting for me—Capt. Fulton, the B-50 pilot, and the three chase pilots, Maj. Childs, Capt. Apt, and Capt. Kincheloe. Capt. Wray had my pressure suit laid out and helped me put it on. I studied my preflight check list a few minutes, then drove back to the flight line for a 6:30 takeoff.

Takeoff was delayed about 15 minutes, so I stood around with the other pilots and the Bell people, talking and watching them finish fueling. I talked to Bob Lapp and Jimmy Dunn about the airplane. But mostly we just stood around and waited, kidding back and forth. There was more than the usual amount of tension in the air and we were all trying not to show it.

At 6:45 Jimmy Powell called the B-50 crew to board the aircraft and activity began to increase. I zipped up my pres-

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sure suit and put my heavy flying suit on over it. One last handshake with the men remaining behind, and I got in the B-50.

We taxied out and received tower clearance, and less than a minute later were airborne. After gear and flaps came up I went back in the B-50 and sat down near the X-2's control panel with Bill Fleming, the Bell panel engineer. Capt. Wray helped me adjust my pressure helmet and strapped it down. Then he connected my bail-out bottle to the pressure suit and strapped on my parachute. I took a last look around the bomb bay and entered the X-2.

CLOSE-UP OF WORLD'S FASTEST PLANE, the Bell X-2 rocket ship that traveled nearly 2,000 m.p.h. It was built of K-monel metal and stainless steel. Its engine developed 100,000 horsepower.

Wray and Ernie Kreutinger, the Bell top-off man in the B-50, followed me down and helped strap me in the cockpit. After I was strapped in and connected to the oxygen and radio outlets, I checked in over the radio with Fulton in the B-50 and Jimmy Powell on the ground. The radio checked okay and I went to the other items on my preflight check list—turning on the circuit breakers, checking hydraulic pressures and flight controls, turning on my oxygen system.

Sunlight was now flooding the B-50 and the X-2 as we climbed laboriously upward, circling slowly in a heavy spiral that would take us to drop altitude six miles above the ground. But below us daylight had not yet reached the desert where the little cavalcade of vehicles moved in semidarkness across the lake bed to take up its position at the south end of the lake. It moved slowly through the main gate, the radio truck leading the way, followed by eight or nine other vehicles carrying the 50-odd men and women who would follow the news of my flight and meet me when I landed. Silently now, listening for any word from the B-50, they regrouped themselves half a mile off the landing strip and waited.

Up in the X-2, Wray and Kreutinger carefully slid the heavy canopy into position and I locked it from the inside, sealing the cockpit against the outside world until I was once more back on earth. Despite myself, I felt a pang of loneliness and isolation when they climbed back into the B-50 and moved out of sight in the bomber.

We were above the clouds now, still climbing, but the overcast had increased. Weather reported by radio that cloud cover was four- to eight-tenths overcast. But looking out of the cockpit, I could see the desert through occasional holes in the clouds and told myself I could pick up a landmark and land safely.

Our course was east, to where I would drop in a westerly direction. On rocket burn-out I should be above Bakersfield, Cal., in position to turn and glide back to a landing. Cloud cover was now seven-tenths overcast and altitude 33,000 feet. With its heavy load, the B-50 would not go any higher. Capt. Fulton nosed over to pick up speed for the drop and his dive carried him 2,800 feet toward the ground. At 7:45 a.m. he tripped the lever that released the bomb shackles in the big bomber. The X-2 fell free in the morning light.

My gloved fingers depressed the locking button on the throttle as I fell and locked it in full-power position. With a force that slammed me back against the cockpit wall, both rocket chambers roared into life and the fiery energy thrust the falling airplane forward. Shaking my head

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to clear it from the shock of the sudden acceleration, I pulled the wheel slowly back toward my pounding heart and began the familiar climb upward.

The X-2 leaped forward convulsively, eating air, and I knew at once that I could not hold it down. Today it hungered for the whole sky. This appetite for speed was ravenous and would not be denied. Again I attempted to keep a predetermined climb schedule, and again the airplane was running away from me. Fighting the controls, struggling to hold a steady flight path, at 50,000 feet I was already supersonic. Very carefully now, afraid of overcontrolling, I began the familiar push-over toward level flight.

Automatically I discounted the time lag in my altimeter and Machmeter. My instruments could not keep up with the fantastic acceleration. Altitude was 50,000 feet indicated, 55,000 true. Rounding out now, I would be straight and level at 60,000 feet indicated, true 65,000.

All the instruments were lagging. I held the control stick with both hands, still pushing forward. My senses were extremely acute and drawn to one point in time, luminous and aware and waiting for the unknown to happen. In my hands I held the reins of 100,000 horses.

Level—now. Ready—now. The airplane accelerated on up and I watched the Machmeter climb to a speed I knew had never before been flown by man. I observed some debris coming over the nose of the plane and hitting the windshield. Worry now, until I thought of paint blistering and coming back over the cockpit. This was the heat barrier.

But I had no time to think about it. I was too busy flying. The airplane handled beautifully. Still in level flight, it continued to drift on upward, hurled skyward by the incredible momentum of its climb. Speed was over 1,900 miles an hour. I felt like an explorer, like Columbus and Magellan. I was both awed and proud.

Except for the hiss of air over the cockpit and the far-off crackle of static over my radio headset, I heard nothing. I was acutely conscious of absolute stillness and calm, a solitary world in which I was suspended, alone in time and space.

Aided by its modified fuel probes, the rocket engine burned four seconds longer than ever before, then sucked the tanks bone dry of fuel and burned out.

I pulsed the ailerons to the left, to the right, then did a stabilizer pulse to the positive position. I could detect very little yaw tendency, but I noted a definite decay in lateral stability. When I released aileron pressure and returned the controls to neutral, the airplane continued rolling in the direction of the control movement, and I had to apply opposite control to stop the roll.

By pulsing the controls, I mean maneuvering, a movement of the stick. If I pulsed the ailerons too far, I knew from the GEDA machine that the X-2 might not stop rolling.

For this reason, I pulsed the stick very gently, just an inch or two sideways, then returned it immediately to neutral to observe the reaction of the airplane. I pulsed it to the left again, then to the right. Then an inch or two in the rearward position. I noted that the airplane was still controllable and I felt it could be flown safely at these speeds or a little faster. However, control was marginal, and if the pilot maneuvered too violently, anything could happen.

When I finally broke radio silence I said one word, "Bingo!" Unless I reported in code, which I forgot to do in my excitement, that was all I could say in the open. But to the listeners many miles below me, it said what they were waiting to hear. This was it—this time we had done it! They knew then that I had approached the higher Mach numbers we hoped to reach.

Glancing quickly out of the cockpit at the toy landscape far below me, I tried to identify my position over the California desert. I reported to my chase pilots and asked if they had me in sight—they did not. Without the exhaust from my rocket engine, they no longer had the guide by which they tracked me.

Giving them what I thought was my position over Bakersfield, I made a right turn back toward Edwards and began my letdown. Speed was still supersonic, and again I performed aileron and stabilizer pulses to test control and stability of the airplane, being extremely careful not to overcontrol. Although engine power was

[*Continued on page 238*]

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How We May Get H-POWER

Authentic data and photos, newly released from secrecy, present an exciting picture of the next atomic wonder: the peacetime use of controlled fusion

By Alden P. Armagnac

WHAT'S behind the headlines you see these days, like "Baby Sun To Aid H-Power Studies" and "British On Way to Use of H-Power"? They're items in the exciting story of what may be the next great advance in nuclear energy—atomic power from fusion. Here are the answers, some of which can only now be given, to the questions a layman may ask about it:

What is fusion?

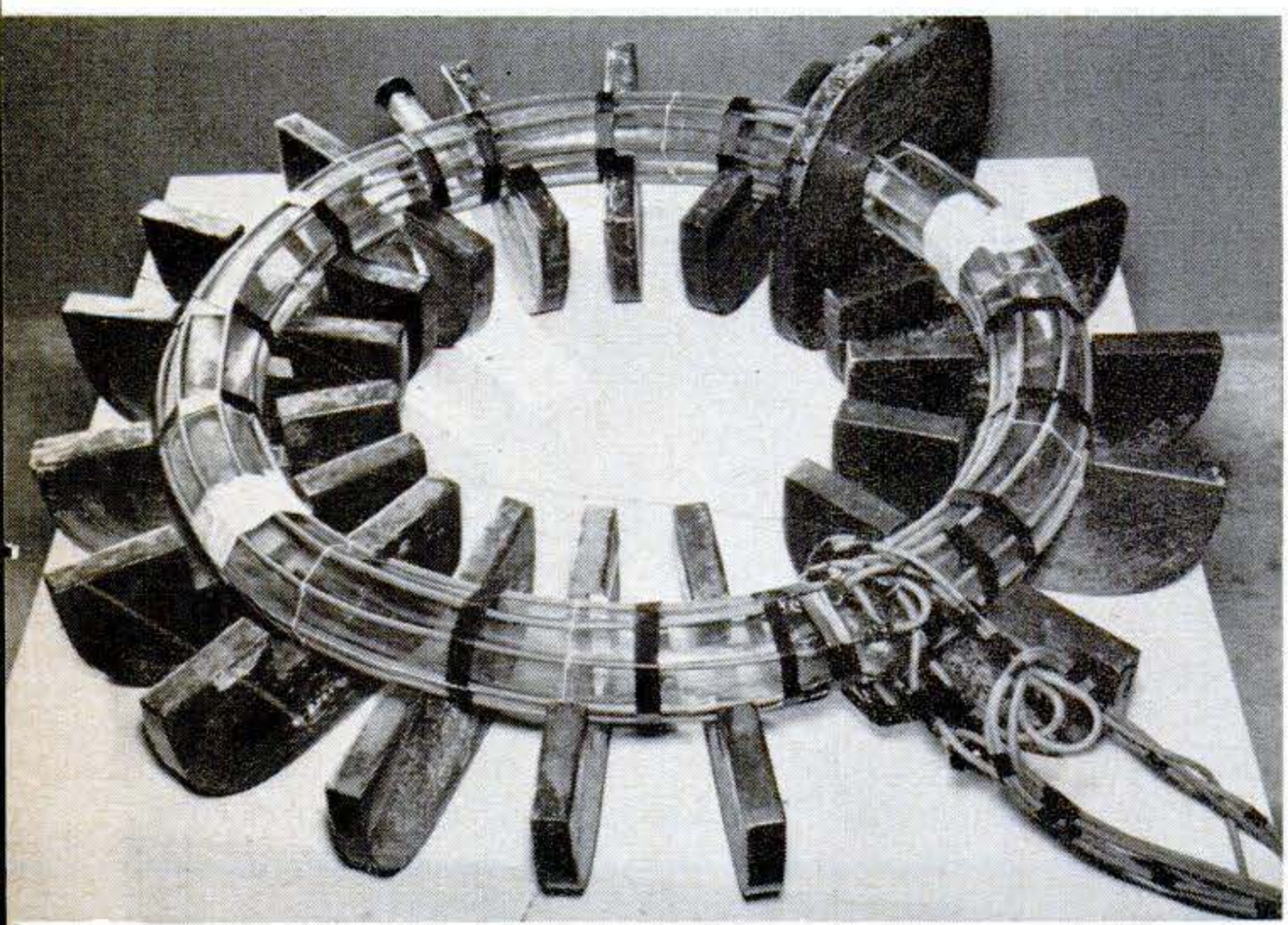
It's the source of the sun's heat, and of the H-bomb's terrific power. Thermonuclear energy is another name for it.

A hydrogen bomb's explosion is a fusion reaction out of control. If fusion could be controlled and tamed, that awesome power could be put to peaceful and constructive use.

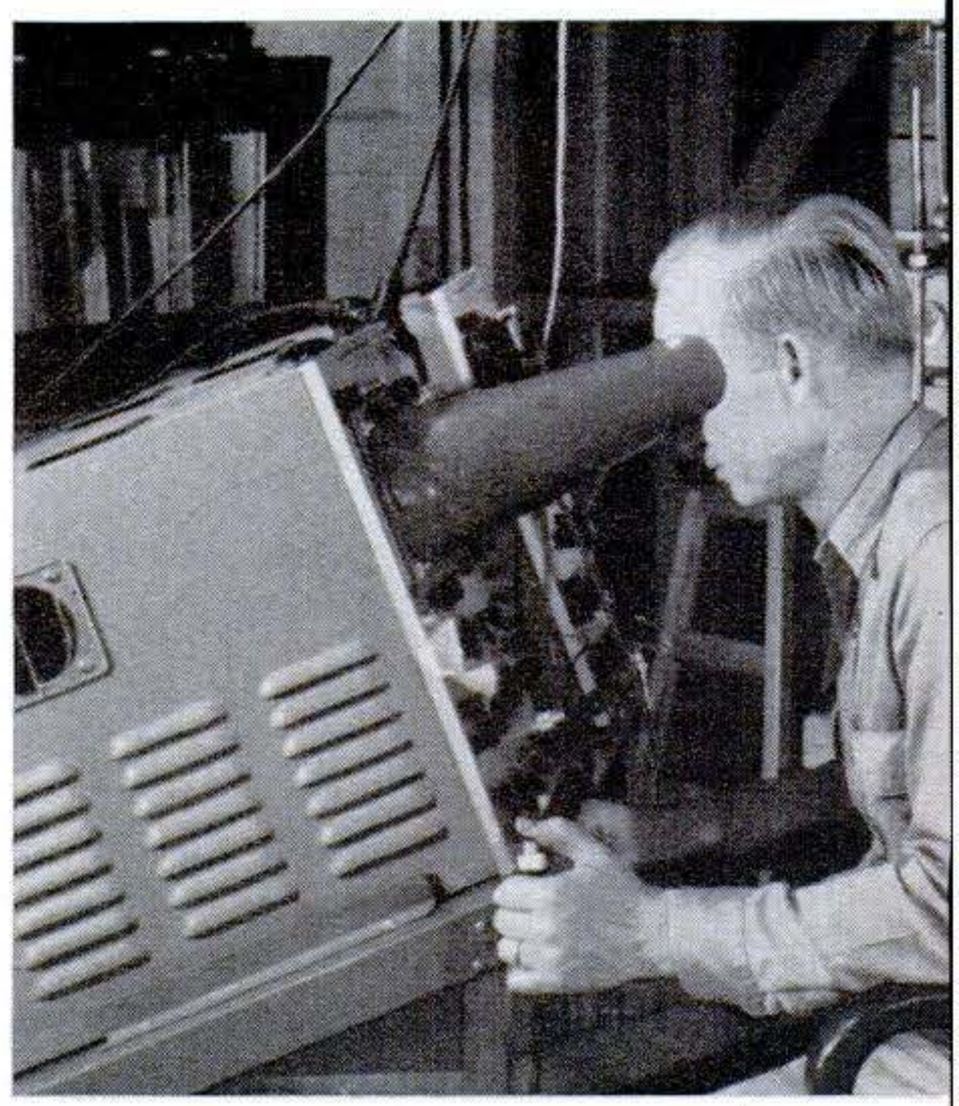
Is that at all possible?

So much progress has been made toward it that now researchers are going from toy-sized experimental models to big-scale apparatus—like the "baby sun" of the headlines, a projected multimillion-dollar U. S. machine called the Model C Stellarator.

Until lately the whole business has been wrapped up in secrecy. But now the wraps have been lifted enough for a peek at what's been going on, from first principles to latest developments.



PERHAPSATRON TUBE, above, and its use to test idea of confining super-hot reaction in magnetic bottle are shown in views now released of long-secret U. S. fusion experiments.



UNDER OBSERVER'S CONTROL, electric discharge of 12,000 amperes applies a magnetic "pinch" to the

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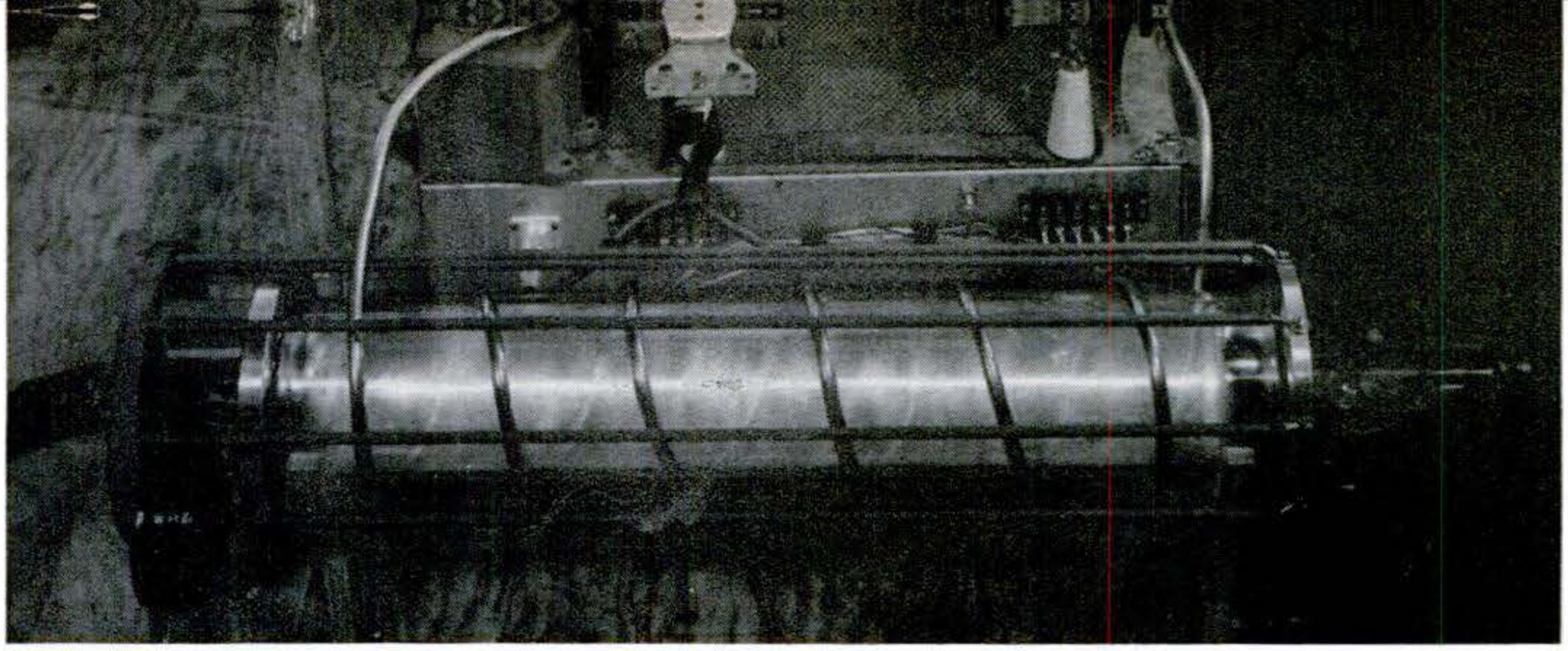


MAGNETIC BOTTLE, named Columbus, pinches hot gas into a luminous line—and gives preview, in miniature, of what the multimillion-degree "flame" of a fusion furnace may look like.

To begin with, what's the difference between fusion and the kind of atomic power we have already?

So far, nuclear reactors run on uranium, or plutonium, or thorium. Those fuels release their energy when the hearts of their atoms split in two. Fission is the name for it.

Fusion is just the opposite. A fusion fuel's atomic particles, instead of splitting in two, join themselves to others. That liberates even more energy than fission does, pound for pound of fuel.

What would be the fuel for fusion?

Deuterium, also called heavy hydrogen, looks like the best. When it fuses, it turns into helium. By-products are ordinary hydrogen, tritium or extra-heavy hydrogen, and many neutrons. That's the overall result of several reactions taking place at once.

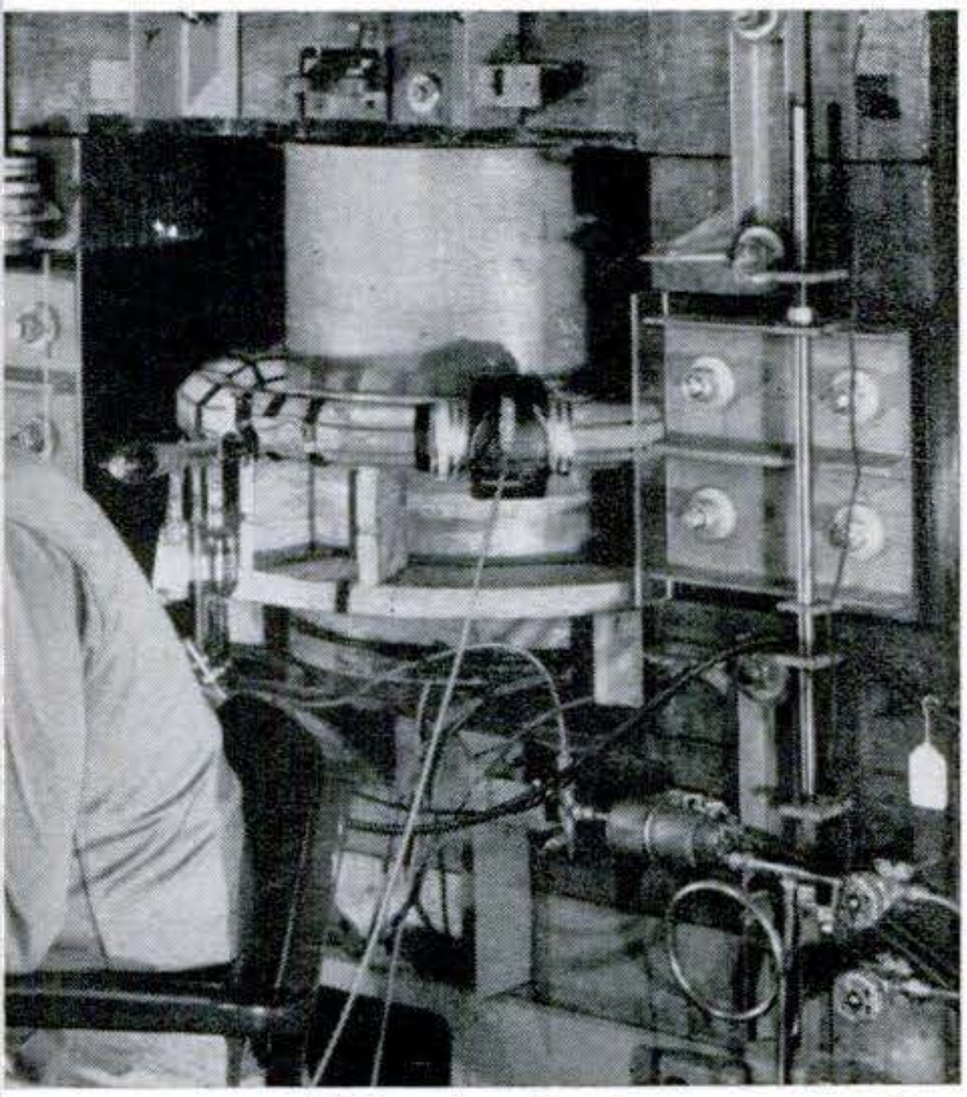
Where do you get the deuterium?

The oceans are full of it. Water—it's H_2O, you remember—contains hydrogen. And about one part in 6,000 of all natural water is heavy water, the kind whose hydrogen is heavy hydrogen.

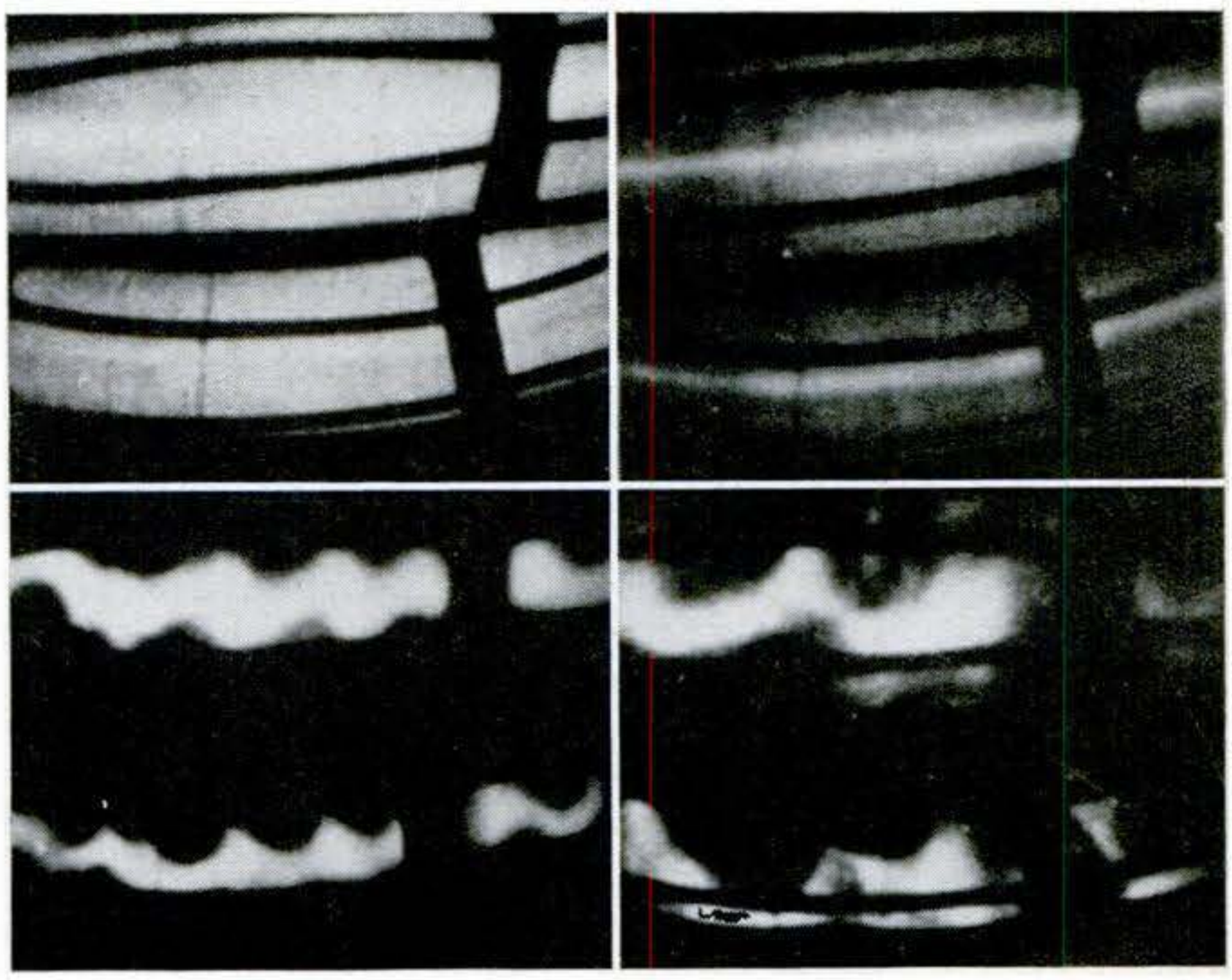
There's enough deuterium in the seas to provide all the world's fuel for a billion years to come, at 1,000 times our present rate of energy consumption.

Is that why we want fusion power?

Yes. There is only a limited amount



gas within the Perhapsatron tube, which has been placed at center of six-ton magnet in background.



GLOW, PINCH (upper right), kinking, and pinch's breakup successively follow discharge, as seen through tube's taped-on wiring. Mirror gave twin side-and-bottom views.

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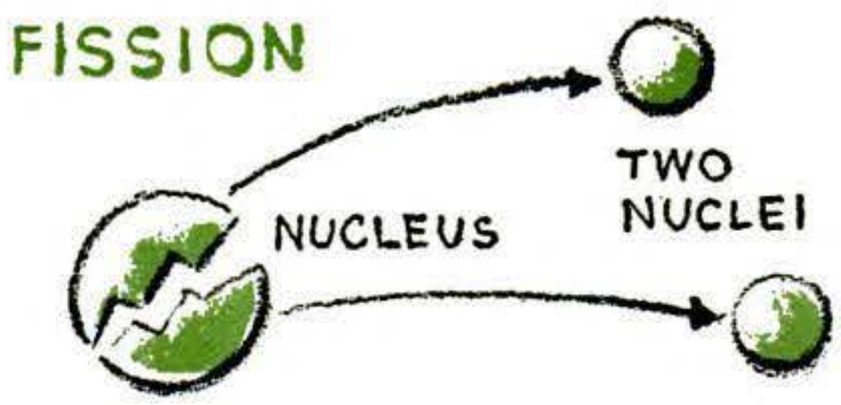
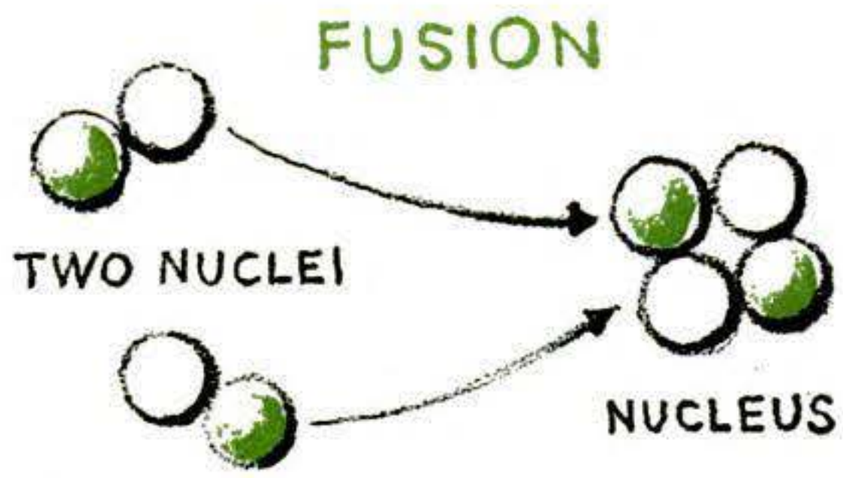
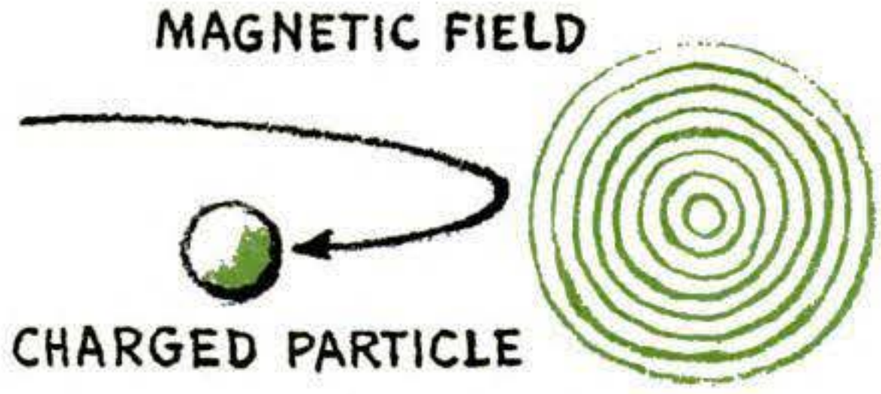
Drawings show principles of H-power, how they might be applied,

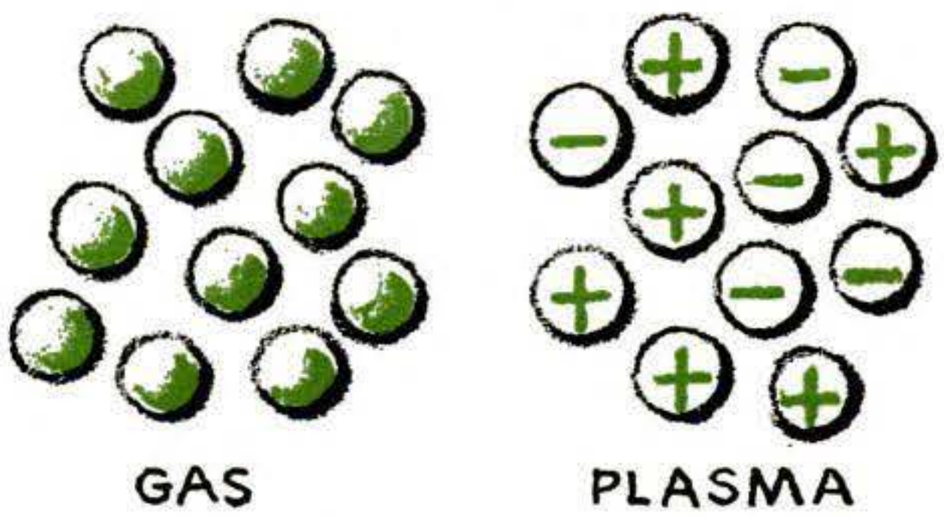




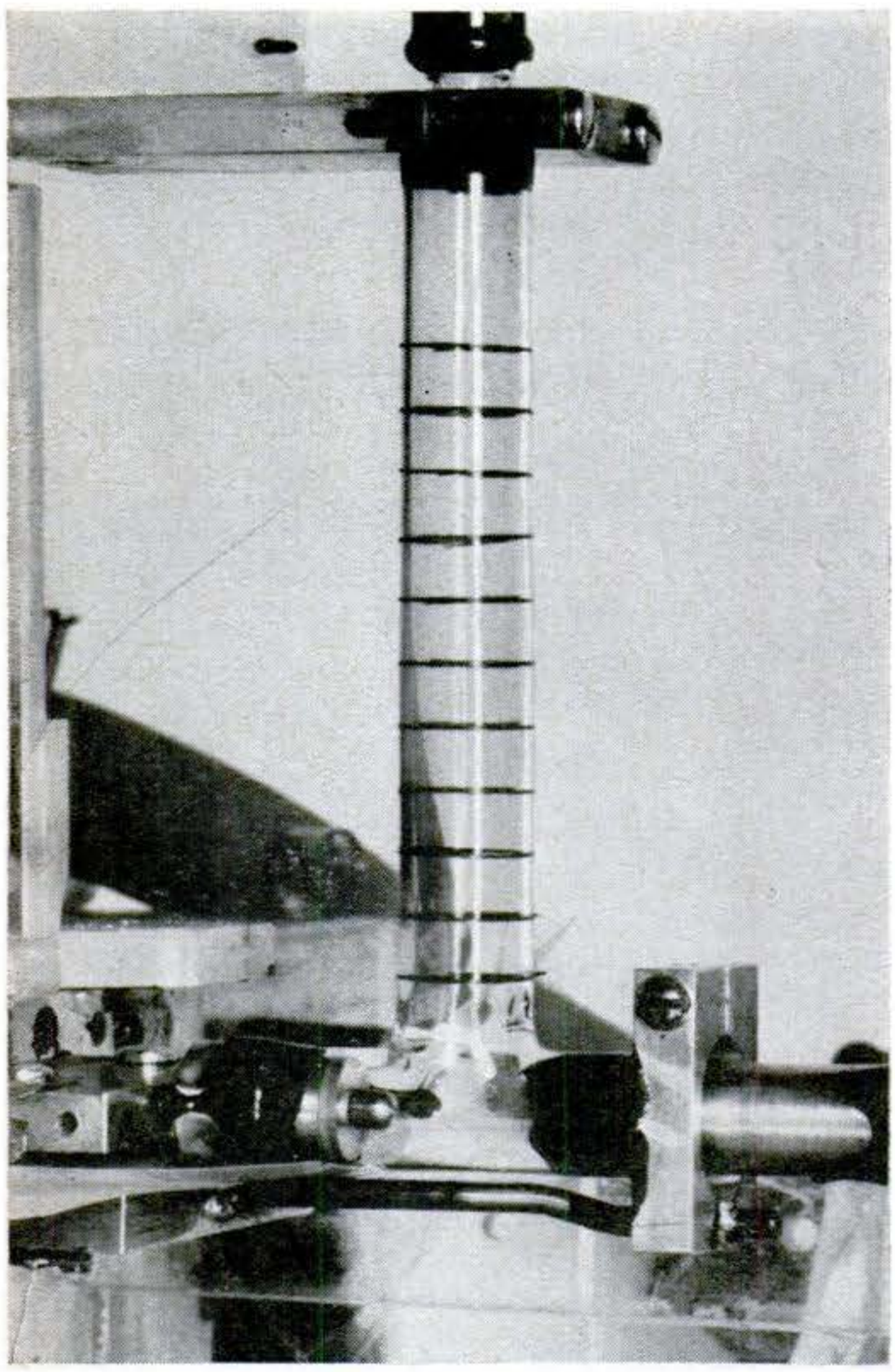
IN FISSION, which gives the kind of A-power we have now, atomic particles split in two. In fusion, they do the opposite, joining to make bigger ones.



MAGNETIC FORCE, which could confine fusion fuel, acts on gas if it is charged.



DEUTERIUM FUEL is therefore turned from ordinary gas into charged one (plasma).



ELECTRIC SHOCK TUBE magnetically drives shock wave upward, through deuterium gas in vertical section, in tests seeking gentle way to ignite fusion reaction. Modified version of tube has given 1,200,000-degree heat, by NRL estimate.

of coal, oil and uranium in the world. Sooner or later we'll use them up. But the supply of deuterium is practically inexhaustible.

How do you extract the deuterium?

First you separate the heavy water—by distillation, electrolysis or a newer method called chemical exchange. Then you can easily decompose the heavy water, with electric current for instance, and get the deuterium. It's a gas, just as ordinary hydrogen is.

Will deuterium be expensive?

With heavy water currently selling at $28 a pound, deuterium by one estimate should cost about $400 a pound. That's a bargain; it will yield 30,000,000 times as much energy as an equal weight of gasoline.

What are we waiting for, then?

There are three staggering problems to lick before we can build a fusion-power plant: how to light the fire, how to put a firebox around it, and how to extract the power.

Take the first one. To kindle a self-sustaining fusion reaction in deuterium, somehow you must heat it to the astronomical temperature of 700,000,000 degrees F.

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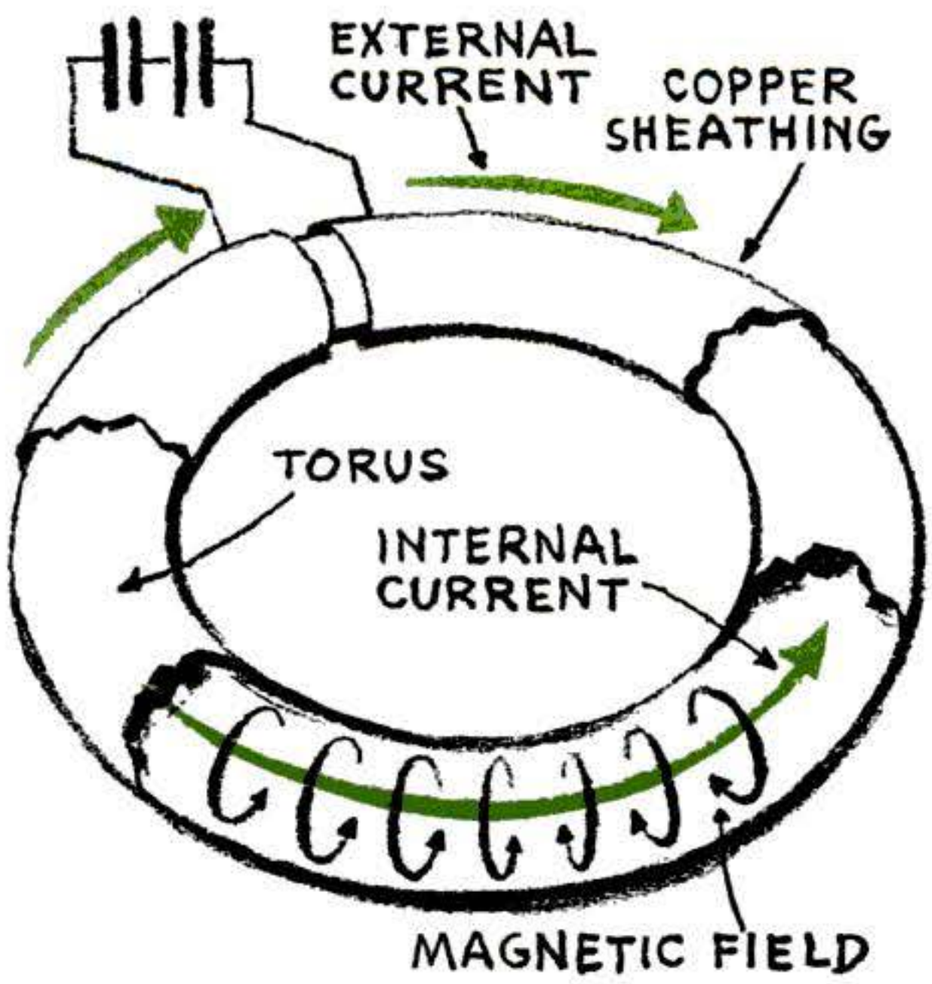
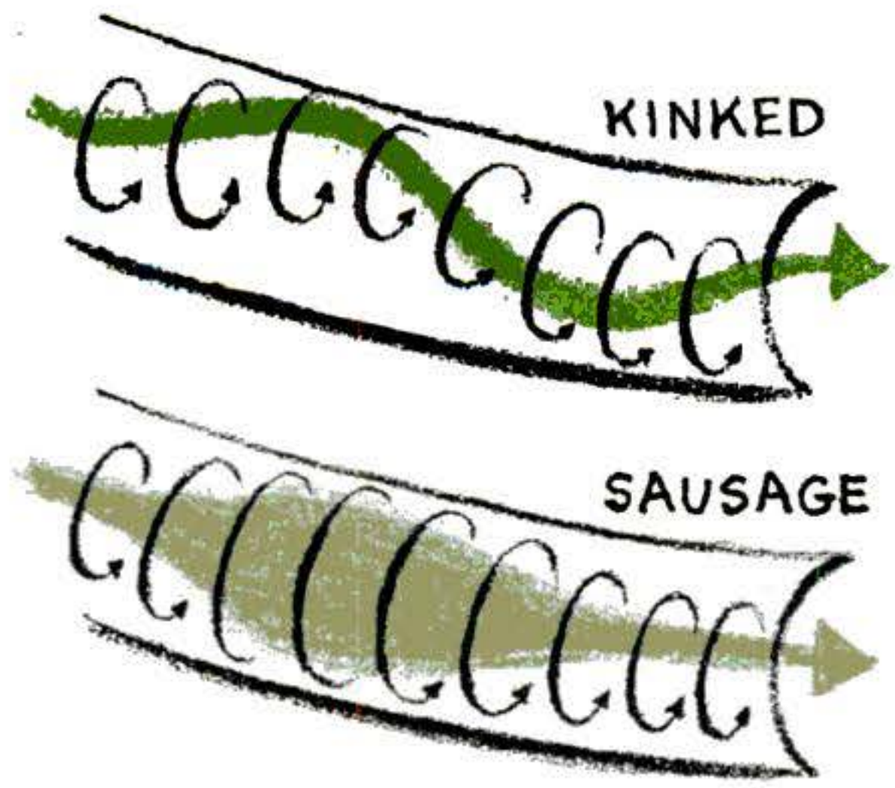
and some "bugs" of early schemes



SIMPLEST MAGNETIC BOTTLE is gas-filled torus (doughnut-shaped tube). Current around sheath induces current in gas, to confine it by magnetic pinch effect.



"INSTABILITIES" of these three kinds plagued early magnetic-bottle experimenters. Instead of holding steady, column of hot gas wriggled, bulged or became fluted in cross section.

Mixing tritium with the deuterium would lower that appalling figure—but it will still take at least 180,000,000 degrees to set any kind of fusion fuel ablaze.

Can we ever manage to do it?

It's actually been done, we know, because a fusion reaction has been brought off in H-bombs. To ignite it, the H-bomb has a built-in A-bomb, which furnishes the multimillion-degree heat. But you obviously can't start a fusion-power plant with an A-bomb, so experimenters have been seeking a gentler way to reach extreme temperatures.

Now they believe that they've found the answer.

How would they do it?

By heating the gas with shock waves. In theory, at least, that could raise a gas directly to "thermonuclear temperatures."

A shock wave is a faster-than-sound wave of pressure, as from an explosion. In fact, some early fusion experimenters abroad actually exploded small "shaped" charges, and made gas so hot that it became luminous (PS, June '53).

Now it's revealed that U.S. and other fusion researchers are using a much more advanced technique, which consists of driving shock waves through a gas magnetically. The waves are propelled either along a tube or, in other setups, from the walls of a tube toward the center. Even on a small scale, results have been rather fantastic.

An "electric shock tube" is believed to have heated glowing deuterium gas to more than 1,000,000 degrees F., in fusion tests at the Naval Research Laboratory. Figures attained in trials elsewhere in the U. S. are still to be disclosed.

Probably there remains a long, long way to go—but the experimenters seem confident that kindling the fusion fire won't be their hardest problem.

What's the toughest one, then?

The firebox is the prize problem. No material exists that can stand up to that kind of heat. Every known substance would vaporize instantly. So your strange task is to construct a firebox out of nothing at all.

Can there possibly be an answer to that one?

Yes—a magnetic bottle.

The idea would be to confine the superhot deuterium gas within a powerful magnetic field, while the fusion reaction took place.

The deuterium would first have been

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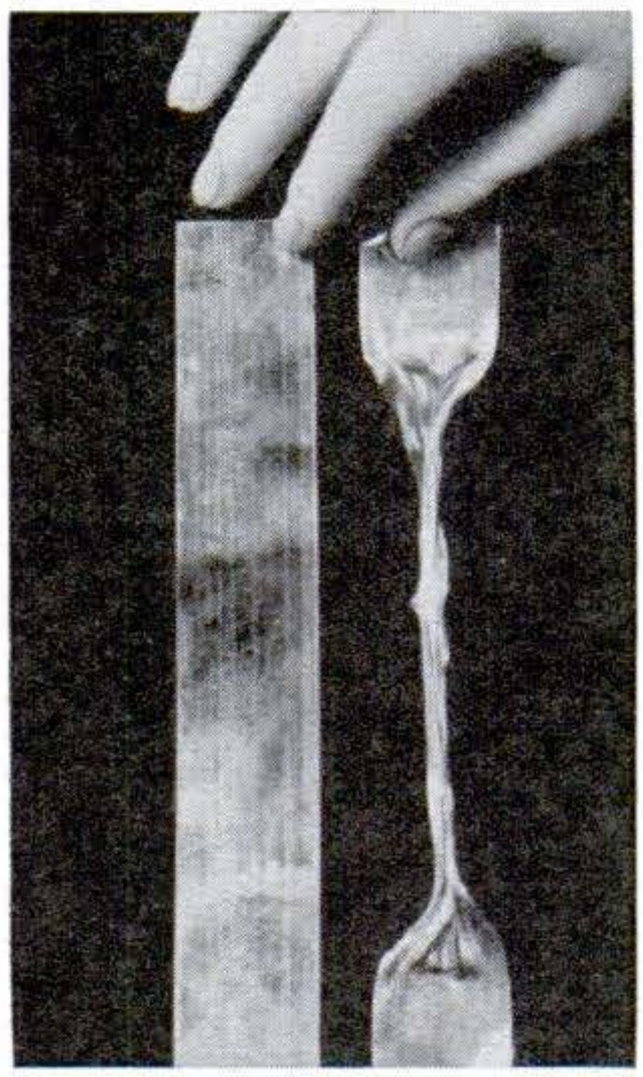
ionized, or charged. Passing an electric current through it, or simply heating it to the extreme temperatures at which fusion could occur, would ionize it. The resulting swarm of charged particles—the fusion workers call it a plasma—will respond to the effect of a magnetic field, although an ordinary uncharged gas would not.

Since there has to be some solid and tangible apparatus somewhere, the "magnetic bottle" actually would be a tube, filled with deuterium to start with. Then magnetic force would hold the deuterium well away from the tube's inner walls, leaving a vacuum along them.

In magnetic-bottle experiments from which the secrecy has just been lifted, this was done by applying a curious phenomenon called the pinch effect.

What, exactly, is that?

A homely illustration of the pinch effect is what happens to a copper drain pipe when lightning hits it. The pipe crumples up as if squeezed in a giant fist. So do flat copper strips given a quarter-million-ampere jolt, in General Electric's artificial-lightning laboratory. The explanation is that the mighty current creates a powerful magnetic field; this, in turn, puts a squeeze on the current-carrying metal.



COPPER STRIP, before and after 265,000-ampere jolt, dramatically illustrates "pinch effect." Metal is squeezed as if by giant fist.

The same thing happens to a tubeful of gas carrying a heavy current, it was first observed in 1951. The current's own magnetic field pinches the gas away from the tube's walls and toward the center. When suddenly discharged through the gas, the current whams it together, and you get shock-wave heating in the bargain.

That was the scheme of working models built to test the magnetic-bottle idea.

What did they look like?

One was an endless doughnut-shaped tube about two feet across, nicknamed the Perhapsatron, and tried out in '52-'53 at the Atomic Energy Commission's Los Alamos Scientific Laboratory. A condenser discharge of 12,000 amperes was shot through electric windings around the three-inch-diameter tubing, and that induced another current in gas within the tube. The gas glowed brightly and, within a few millionths of a second, an exciting thing happened. The glow shrank to a luminous thread along the tube's center. Magnetic force was pinching it—as they'd hoped it would.

A second magnetic bottle built by the Los Alamos team was a straight quartz tube, about a foot and a half long, called the Columbus. Through gas in this tube, a triggered spark gap hurled more than 100,000 amperes of current, pinching the glowing gas into a luminous line down the center.

Encouraging as this looked, the trials showed there was a catch, so serious that it threatened to wreck the scheme.

What was that?

The pinch didn't last. Quicker than you could say "pshaw," the glowing thread of plasma would wriggle, kink, and break up.

A current held by its own magnetic field, it turned out, had unruly ways of behaving—"instabilities." It strayed into a winding path—and then, like a meandering river, it kinked more and more. Or, when the "pinch" happened to squeeze the plasma a trifle sooner in some places than others, you'd get alternate pinches and bulges like a string of sausages; and the bulges rapidly grew.

An alternate magnetic-bottle scheme, providing an external magnetic coil to confine the plasma, struck a similar snag. In this case the column of plasma, departing from a nice round cross section, took on a more and more fluted shape.

Why was that bad?

First, the pinch didn't hold steady for even the second or two that it might take to start a fusion reaction.

Worse yet, the kinks or bulges or flutings quickly reached the tube's wall—

[Continued on page 240]

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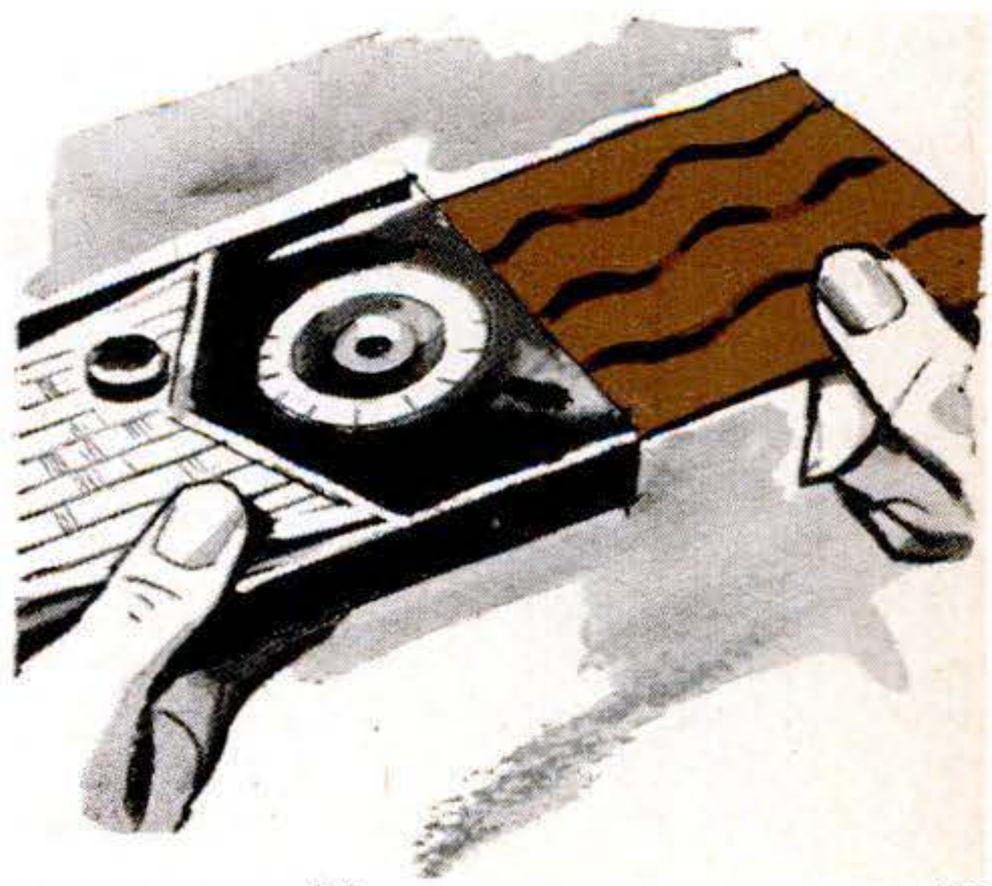
New Ideas from the Inventors

1 V Plows Clear Tracks in Snow. With these recently patented wheel plows hooked to the bumper, even a light car or truck might be able to dig its way through snow. For instead of trying to bulldoze tons of snow to clear a car-wide path, the plows would merely slice out two narrow tracks for the wheels.

2 Clothesline Unreels Pins. A housewife wouldn't have to fumble with loose clothespins to hang wash on this line. Permanently—but slidably—attached to the line, pins stored inside the pulley housing would travel out with the line, go back as the line was reeled in.

3 Printed Batteries Save Space. To form dry cells on thin sheets, this inventor would orient metallic-ink particles magnetically. The proper electrochemical action could take place, he says, because each layer could be made conductive without direct layer-to-layer contact.



Please turn the page for more new ideas

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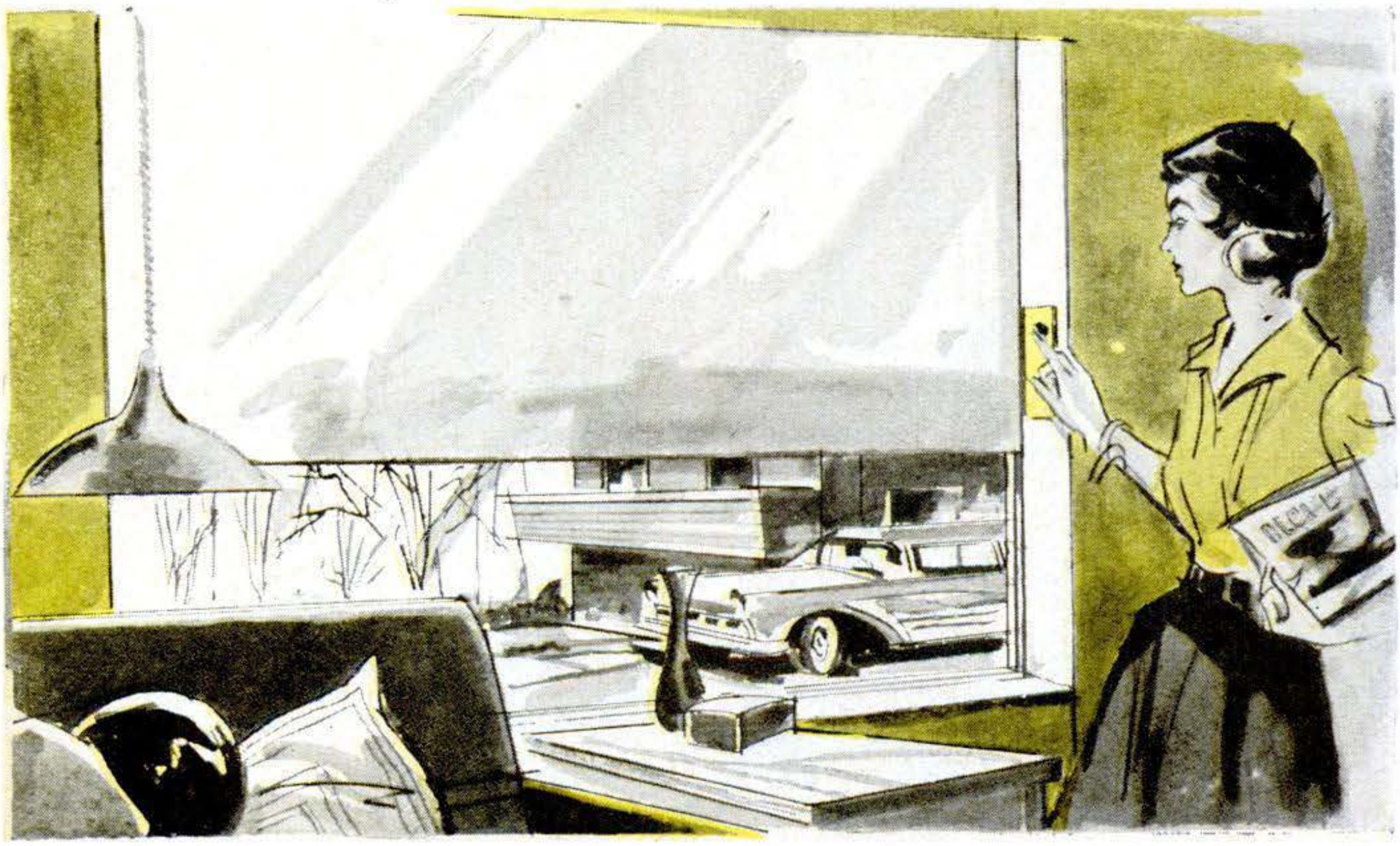
More Inventors' Ideas

4 Plate Clip Holds Butter Knife. Buffet meals might be easier to eat if hostesses provided plate-edge clamps like those shown above. Slipped onto the rim of a dish, the clamp would provide a non-skid holder for a pat of butter and a spring gripper for the butter knife.

5 Spinning Mirror Sheds Snow. Keeping a rear-view mirror whirling rapidly wouldn't affect the images it reflected, but should keep snow, sleet or rain from settling on the glass. The mirror's shaft could be battery- or wind-driven, or powered by engine vacuum.

6 Liquid Clears Picture Window. You wouldn't have to sacrifice light for privacy with a window like this. Two sheets of translucent glass would normally admit light while blocking the view. But by pumping between the panes a liquid with the refractive index of the glass, you could make them transparent.



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7 Radiation Tags Forgotten Sponge. To provide a sure and simple way of accounting for all surgical sponges used in an operation, this inventor would embed pellets of harmless radioactive material in the gauze pads. After the operation, a Geiger counter could track them down.

8 Collar Coils Dog's Leash. Instead of unhooking this leash when you wanted to let your dog run free, you'd just drop the end. A spring would coil the leather strip inside the collar. A sliding license-tag holder would adjust the length that could be drawn against the spring, and thus permit a quick change from a short leash to one of normal walking length.

9 Hand Truck Climbs Stairs. The motor on this heavy-duty hand truck would either drive it across a floor or ramp, or lift it up a stairway step-by-step. Small rubber rollers would engage a stair tread as shown. After the driven sprockets had lifted the main wheels to stair level, the rollers would engage the next step.

The following patents *have been issued on these inventions: 1. Patent No. 2,722,064 to A. Jaffe, University Heights, Ohio; 2. No. 2,586,632 to M. Esposito, Gloversville, N. Y.; 3. No. 2,688,649 to J. Bjorksten, Madison, Wis.; 4. No. 2,739,465 to D. Soderblom, Ardmore, Okla.; 5. No. 2,737,852 to C. Porter, Center Moriches, N. Y.; 6. No. 2,783,682 to O. Swenson, Crystal Lake, Ill.; 7. No. 2,740,405 to H. Riordan, Oak Park, Ill.; 8. No. 2,799,245 to A. Ruggiero and C. De Ninne, New Rochelle, N. Y.; 9. No. 2,740,484 to J. Montana, Glendale, Calif.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

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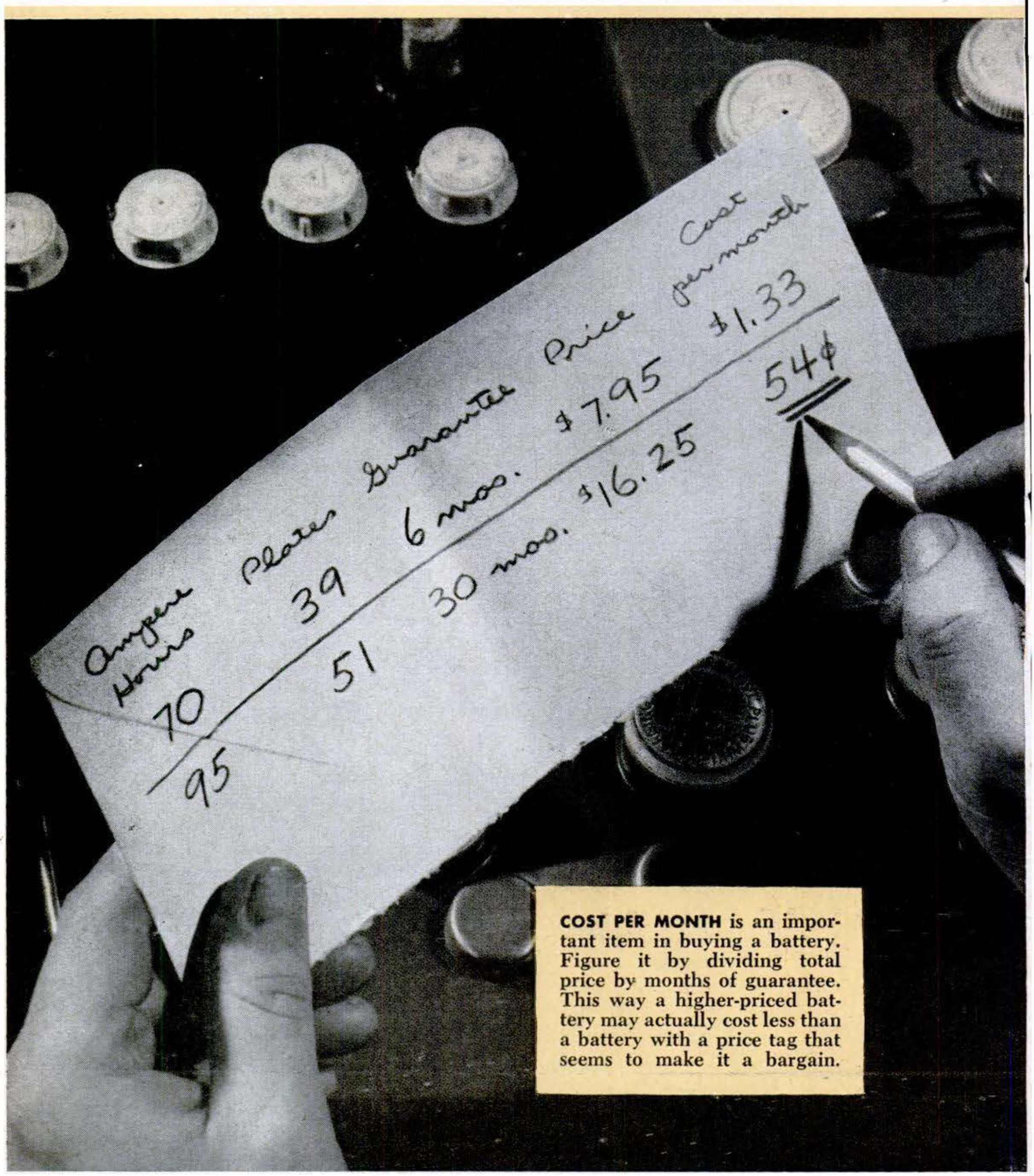
How to buy
The Right Battery for Your Car



COST PER MONTH is an important item in buying a battery. Figure it by dividing total price by months of guarantee. This way a higher-priced battery may actually cost less than a battery with a price tag that seems to make it a bargain.

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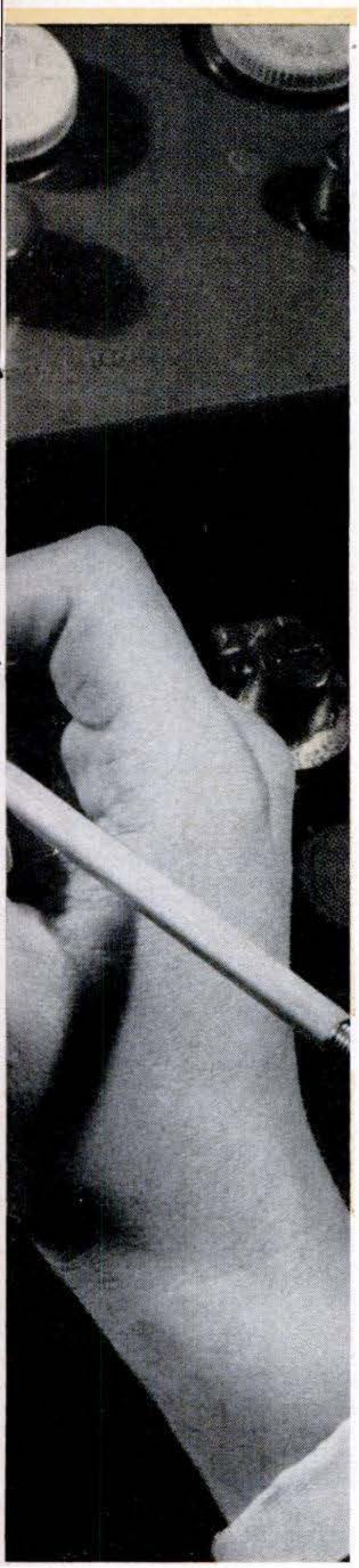
Do you need a new battery—or just a recharge? How much capacity does your car require? How can you figure true battery cost? Here are the facts



By Edward D. Fales Jr.

IT'S late afternoon. You're in a parking lot miles from home. Your starter groans and quits.

"Battery's shot," says the gas-station fellow, looking you in the eye.

"How much for a new one?" you ask.

He looks in a book. (Somehow you're always suspicious when a dealer goes for the book.) He says: "$37.95."

You indulge in a moment or two of verbal wrestling, but you're licked before you start and you know it. "Look," he says, "it says right here. For a 1956 Plyforlet sedan, 12 volts, 54 plates, 65 ampere hours. $37.95."

So you buy it and drive home. On the way you seem to remember paying $12 for a good battery. What became of $12 batteries? Are they still around?

Back home, you pick up a mail-order catalog. Staring you in the face is a battery with a 15-month guarantee. You suddenly remember: You drove off without your guarantee.

But what startles you is the price: in big type, $7.75. You start to blow your top. Then you see it's a six-volt battery.

Then you see something else: This little six-volt job actually costs only $5.75 because the buyer gets a $2 allowance. You got no trade-in allowance at all. (You forgot to ask for it.)

Now you're wondering: Were you "taken?" Did you, in fact, need a new battery after all? Or did yours just need charging? What *could* you have done? Here's what:

- Make sure the dealer tests the "dead" battery.
- Don't waste time looking for bargain or miracle batteries. There aren't any.
- The battery that costs most at first may actually cost less in the long run.

Take that little $7.75 battery. To begin with, that's factory price. Who goes to a factory to buy a battery? In a retail store it's $8.45.

And the seller himself tells you it will cost you 52 cents a month to use—if you spread the purchase price over the 15-month guarantee time. Right next to it he advertises a huskier six-volt job for $14.15 (factory). This one gives not 80 but 115 ampere hours; cranks at zero for 3.6 minutes. And this one has a four-year guarantee. Cost per month (if you use it four years): only 28 cents. So the $14.15 battery on a long-term basis actually costs you half as much as the $8.45 battery.

One of the big users of car batteries is the Hertz Co., which rents out more than 30,000 automobiles all over America. Hertz

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How to tell whether you NEED a new battery

BEFORE you buy a new battery, you should make certain that all life has gone from the old one or is about to go. Here's how to check:

1. Test with a voltmeter. Have your serviceman prod each battery cell with a voltmeter. If the difference between the highest cell and the lowest one is .05 volts or more, the battery is nearing the end of its useful life and should be replaced.

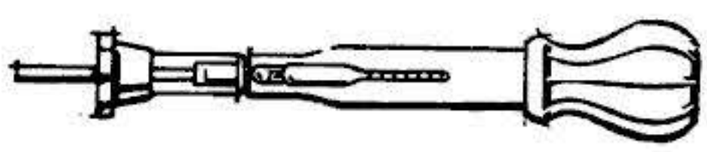
However, if the highest cell reads less than 2.03 volts, the test should be considered doubtful. Have the battery recharged and repeat the test.

Here are two typical sets of test readings, illustrating good and bad conditions:

1st cell	2nd cell	3rd cell	Condition
2.07	2.06	2.06	OK
2.09	2.02	2.08	worn out

State of charge: To tell exactly how your readings rate, check them against this standard:

2.10 . . . . 100% charged (excellent)
2.07 . . . . 75% charged (fair)
2.03 . . . . 50% charged (recharge)
2.00 . . . . 25% charged (bad for battery)



2. Or test with a hydrometer: Have your serviceman read the specific gravity of each cell and compare the readings. If the difference between the highest and lowest cell is .050 (50 points) or more, the battery is near the end of its life and should be replaced. If highest cell reads less than 1.190, the test is doubtful (see above) and must be repeated after recharging the battery.

Typical readings:

1st cell	2nd cell	3rd cell	Condition
1.230	1.220	1.220	undercharged but OK
1.250	1.180	1.240	worn out

State of charge: Some hydrometer scales show this directly in percentage of charge. If your serviceman's does not, compare his readings with the following:

1.260 . . . . 100% charged (excellent)
1.230 . . . . 75% charged (fair)
1.200 . . . . 50% charged (recharge immediately)
1.170 . . . . 25% charged (bad; could ruin battery)
1.110 . . . . (discharged)

naturally has given batteries a lot of thought. Hertz's national maintenance boss, G. H. Maxwell, says:

"The best gauge of value is cost per month. If a battery sells for $18 and is guaranteed 18 months, the cost is $1 a month. If a $24 battery is guaranteed for 30 months, or a cost of 80 cents a month, it would be a far better buy . . ."

Tips: (1) Get your guarantee—in writing. (2) Register your battery immediately by sending in the date-of-purchase slip.

And know what your guarantee is. Most big makers give you a new battery if yours is found defective in 90 days or 3,000 miles (whichever happens first).

After that, you get a cost adjustment based on "units of use." A unit may be either one month or 1,000 miles. Low- and medium-priced batteries are guaranteed for from 15 to 24 units. High-priced batteries are guaranteed for 30, 36 and even 48 units. One big seller gives a flat five-year guarantee on his best battery.

Know the ampere-hour rating. Somewhere stamped on a new battery you should find a number. Let's say you use a six-volt battery. The number might be 70, and it's important.

It means that your battery, theoretically, could pour out one ampere per hour for 70 hours—it has a 70-ampere-hour capacity.

Now a new 70-a.h. battery may be just fine if you live in a mild climate, you don't load your car with power gadgets and you drive enough to keep your battery well-charged.

But suppose you face tough winters, use radio, heater and extra lights a lot, and drive the car mostly on short trips around town? Short trips pull a lot of power and your generator doesn't have time to put it back.

Then you want an 80- or 90-ampere-hour battery. Or you might go to 100, 105, 115 or even 120.

What about 12-volt batteries? If you have a new car and use a 12-volt job, chances are the number printed on the battery ranges between 45 and 65. That's because 12-volt batteries have lower ampere-hour capacity. (Having twice the voltage, they need less amperage.)

If you're using a 50-a.h. battery, and do mostly city driving, with quite a few

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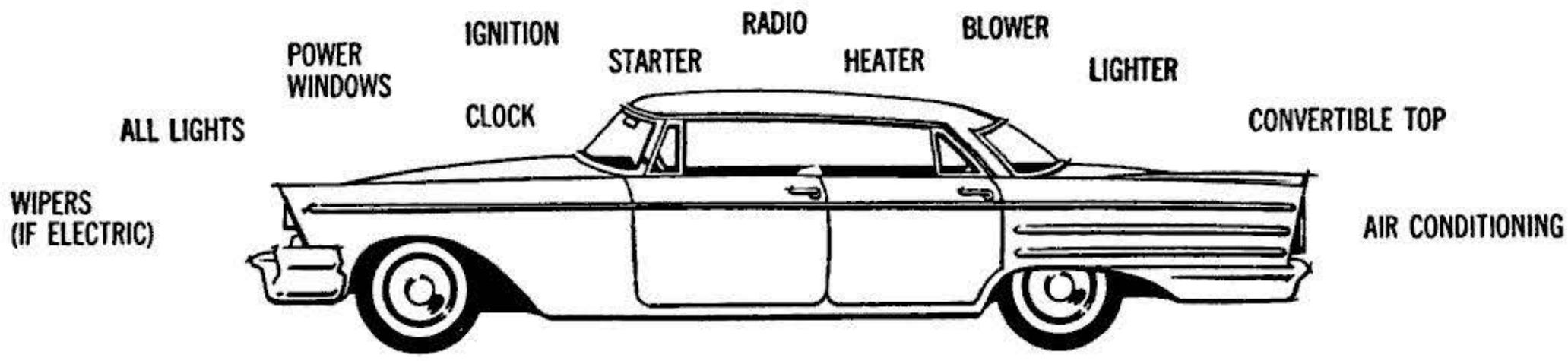
A battery must provide power for . . .



HEAVY ELECTRICAL DRAIN in a modern car could quickly kill an inadequate battery. That's why you can't risk buying a weaker battery than the one that came with the automobile. If you add air conditioning or other accessories you may need a still stronger one.

electrical accessories, you may want to go up to 55, 60, 65 or (in larger cars) 72. Price goes up with ampere hours. But so does guarantee time.

Check the cranking time. On some battery cases you will find another number next to the ampere-hour rating. This tells you how many minutes, at zero degrees F., your battery is guaranteed to turn your engine. (This is an important figure to know; if it is not printed on your battery be sure to find out what it is.)

When you turn the switch, your starter pulls out gobs of power. On a warm day, this "draw" may be 300 amperes. On a cold day, it may jump to 450 or even 650.

This demands a battery with plenty of reserve power because at zero degrees all batteries get quite feeble. (They're only 40 percent as strong as on a hot day.)

Some batteries are guaranteed to pour out 300 amps for 1.7 minutes of zero cranking—and you will find 1.7 printed on the case. One example is a 70-a.h. six-volt battery that sells for $13.85. The same maker's 100-ampere-hour battery cranks for 3.5 minutes and costs $20.45.

How many plates do you need? When you crank, the acid literally storms the lead plates in your battery. The more plate area the acid can attack in a split second, the more starting power you get.

Unfortunately, most manufacturers are quite secretive about plate area. They don't publish figures. But they do publish the number of plates.

The number of plates can fool you, however, since they aren't all the same size. Large batteries may have larger plates, but not always. Some "bargain batteries" look just as big as costlier batteries, but contain much smaller plates. Many of these batteries go into used cars.

Rather than *number* of plates, base your choice on ampere-hour capacity. This capacity varies directly with plate *area.*

What about a dry charge? Some batteries are filled with acid and water at the factory. Others aren't filled until the dealer sells them. These are called "dry-charged."

Dealers like them. Factory-filled batteries on a shelf deteriorate unless the dealer keeps charging them. But when a dealer stocks an empty battery he can forget it until you come in to buy it. Then he fills it, shoots a quick charge into it, and off you go. This takes about a half hour.

Such a battery costs a dollar or two more. But you do get a "fresh" battery. It hasn't begun to live—or age.

Never accept a partly charged battery. You pay for a full charge, no matter what kind of battery you buy. Get it. If a battery has just been taken off the charger each cell should report in at 2.12 volts or a trifle higher. If it's been standing a few hours, cells should test evenly at 2.10 volts.

A hydrometer test should show a specific gravity reading of 1.260 at 80° F. (Be sure your dealer corrects for temperature. He has a correction table.)

To buy a partly charged battery is dangerous. If you rush off on a long trip, your generator may bring it up all right. Otherwise, it may remain partly charged for weeks in your garage, or on short trips around town—and that may take weeks off its life. (It is particularly important to have a dry-charged battery fully charged when your dealer puts it in your car.)

Are 12-volt batteries more reliable? No. The 12-volt is no more, no less, reliable than the six-volt. Maybe you've

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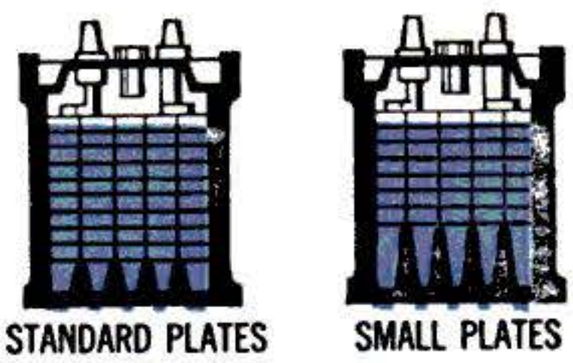
heard that 12-volt batteries sometimes quit in dense, slow traffic. That's not the fault of the batteries. Today's 12-volt cars have lots of electric gadgets. The battery drain, in stop-go-idle traffic, is something terrific. Your generator as a rule doesn't cut in until 18 m.p.h. or thereabouts. So when you creep through traffic you "starve" your battery. This is the biggest single reason for buying enough ampere-hour reserve.

You may ask: But since a 12-volt battery has only about half the ampere-hour reserve, won't it quit sooner than a six-volt? No. That's because, with twice the voltage behind it, it is capable of the same total amount of work. Remember: Work depends on voltage times amperage.

Recent improvements: Battery cases are stronger, less apt to crack or warp. Some are said to have 50 percent more impact resistance than a few seasons back. Many low-cost cases are made of a bituminous composition or plastic; many higher-cost cases are made of hard rubber. All are molded in one piece, with tops sealed on.



BATTERY SIZE is no assurance that you get your money's worth. Some may look just as big, yet give you less plate area because of false bottom.

Plates are stronger, last longer than a few years ago. All plate separators used to be made of wood, and many still are. But overcharging can char wood, and so separators of plastic, porous rubber and fiber are being widely used. Sometimes glass-fiber mats are used between separators and plates. These help hold the lead "active materials" in place so they won't slough off the plates and weaken plate-power.

Some fill plugs are improved: to prevent overfilling and make filling easier.

The electrolytic fluid is a weaker acid mixture than formerly. Lately, manufacturers have found that batteries perform just as well with a fluid of only 1.260 specific gravity (1.260 times as heavy as water). In older batteries it was 1.280. The weaker acid lets your battery live longer.

What about "special alloy" batteries? It's worth knowing that all battery plates contain a sneaky sort of metal called antimony. Antimony is needed to beef up the plates and put backbone in them when they're molded. But antimony is a traitor in a way. It has a bad habit of slipping out of the positive plate and going over to the negative plate, taking with it tiny charges of your valuable electricity. Result: Your battery runs down slowly when not in use.

Lately all manufacturers have found they can cut down on the amount of antimony, and some have gone a step further. To seal the antimony in the plates, various alloys are now used as "jailers." One of these is silver cobalt.

How effective are the new alloys? There is no general agreement yet among manufacturers. Some makers think they help a good deal; other makers doubt it.

What about the nickel-cadmium battery? Just relax. It does a fine job in planes and locomotives. But it costs four or five times as much as your lead-acid battery. Chrysler offered it for a while as an option on some high-priced cars, but later discontinued the option. Reason: "It costs too much."

The Sonotone Corp., which makes it in the U. S., isn't aiming at the auto market. Some experts say the battery works wonders in sub-zero climates.

But even pioneers like the Sonotone people say that under *most* conditions you're well off with the right package of plain old lead and acid. END

Next Month: Why Kill a New Battery?

You can buy a new battery every year. Or you can buy that same new one every three years. What you spend this way depends largely on how you take care of that all-important energy-storage box. Next month's Popular Science will feature another revealing article about batteries. It will tell you how to make a new battery last many, many months longer.

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New Home Incinerators Burn Their Own Smoke

Hold a match in a cigarette's smoke; the smoke disappears. The same principle of two-stage burning makes new indoor trash burners truly smokeless

THE home incinerator has been brought in from the back yard. After more than six years of laboratory research, new smoke-free and odorless incinerators have been perfected for use inside homes. Makers are introducing them this month.

The new models are trim little gas burners. You install one in the basement, utility room, even the kitchen. They have been designed for acceptance in communities that now restrict or forbid the use of conventional incinerators.

They'll burn anything except metal and glass. Bones, sweepings, paper and wet and dry garbage are reduced to a white powdery ash. Spread on flower beds, this makes a fine mulch, say experts.

Afterburner eliminates smoke. Conventional incinerators have a single combustion chamber that does not always fully burn all of the waste. Sometimes unburned particles are blown up the chimney, producing smoke and odors.

The new models work on the 100-percent combustion principle long used in big commercial incinerators. They have a main combustion chamber, plus a second chamber—the afterburner. Any unburned particles that get away from the first burner are completely consumed by the second one. Result: no smoke or odor to go up the chimney.

They're tested. To meet anti-smog requirements of many communities, the American Gas Association set up stiff

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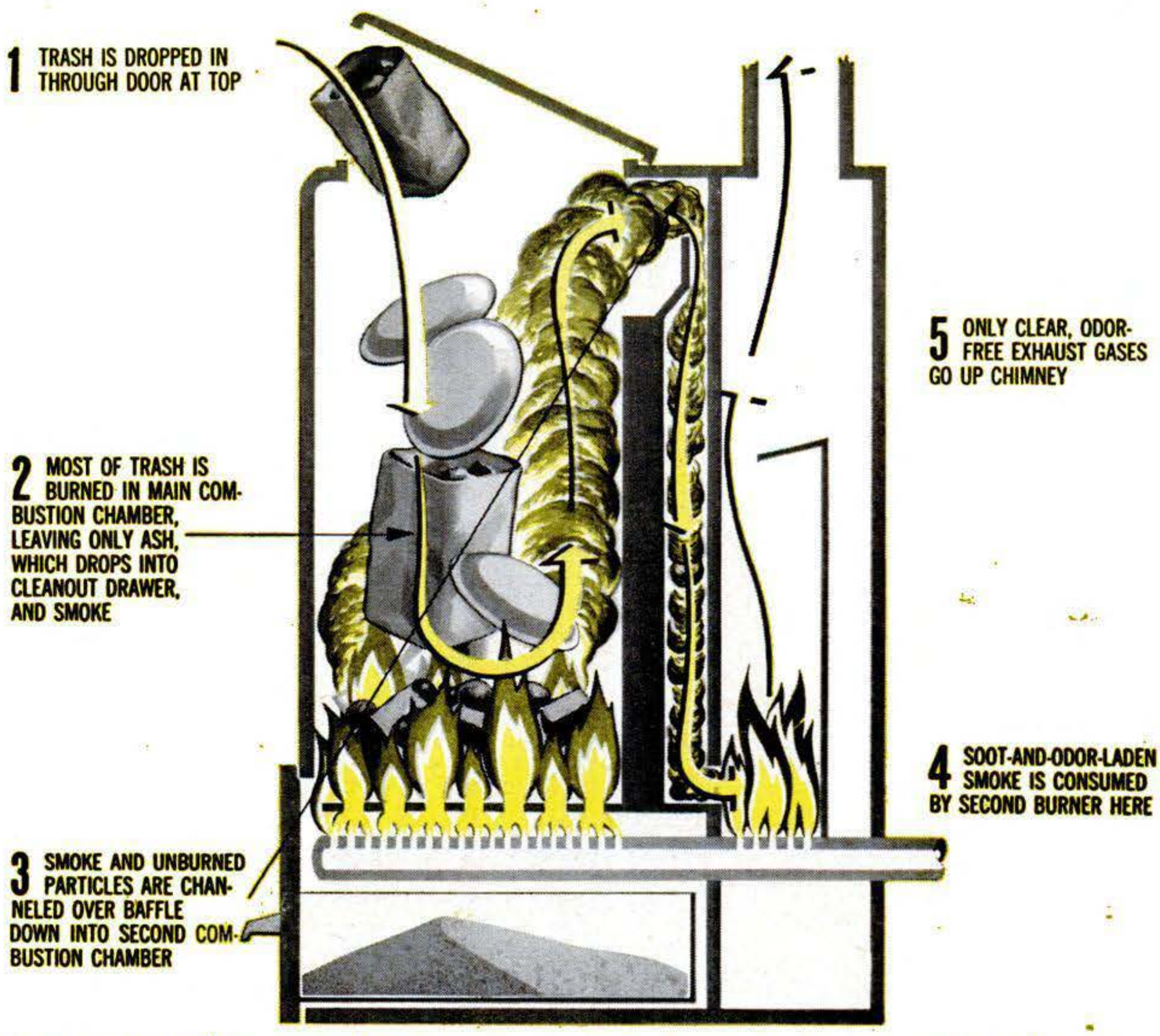
How the new two-stage home incinerators work



SECRET OF CLEAN WASTE INCINERATION is the second burning that consumes particles and eliminates noxious odors that otherwise would escape up the chimney as "smoke."

standards for each manufacturer to meet.

To date, seven new makes have full AGA approval or are expected to have it soon. They are Bowser (Smogmaster), Calcinator, Caloric, Locke Stove (Warm Morning), Majestic, Martin Stamping, and Waste King.

Sales are expected to hit 200,000 a year almost immediately, eventually climb to a steady 400,000 a year. (Sales of conventional gas incinerators have reached, all told, a relatively puny 400,000 over the past 10 years.)

They're inexpensive. The new incinerators will sell for about $175 for one with a 1½-bushel capacity, up to $225 for two-bushel models. By home-appliance standards, this is a modest price, say the makers, for a machine that will do a quick, clean job of removing up to 75 percent of daily household waste. Other types of disposers get rid of as little as 15 percent, they argue, because they're limited to food waste only.

Operating costs run about three cents a day, or $1 a month. Installation may cost from $20 to $50, though some dealers are expected to toss it in free to encourage sales. You need two hookups, a flue vent to your chimney and a connection to the gas supply. Any type of gas will do—manufactured, natural or bottled.

Most chimneys are big enough to take on an incinerator along with the furnace, but they must be of the Class A type (masonry or factory-built). Class B chim-

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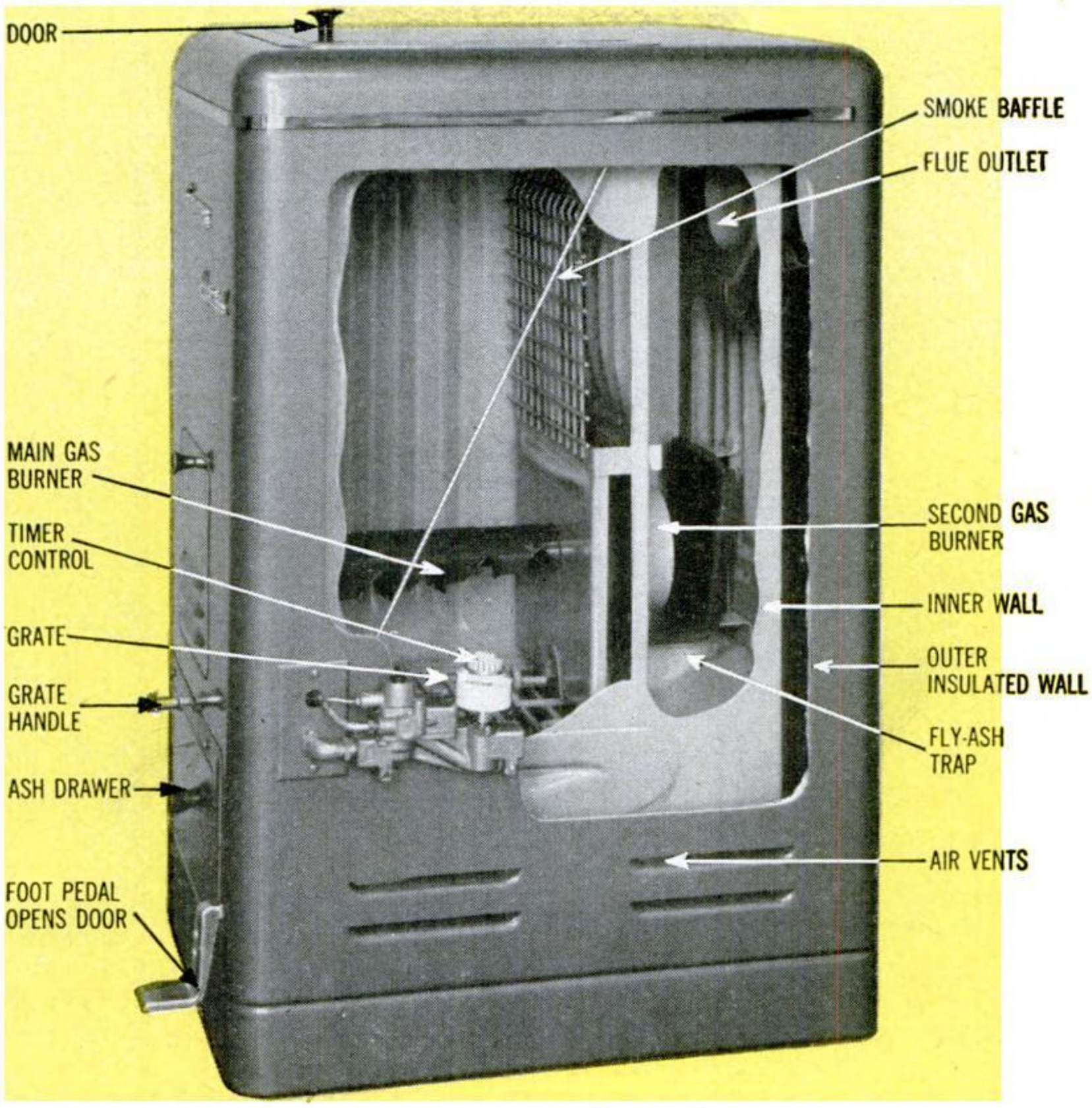

INSIDE A NEW TRASH BURNER. It took the industry six years to design the right combination of burners, baffles and flame control to insure 100-percent combustion.

neys, a low-cost variety found mainly in the South and West, won't withstand the high-temperature incinerator exhaust.

For economy and appearance, it's best to keep the connection to the chimney as short as possible, which means placing the incinerator against or near it. If you don't have a chimney or it isn't easily accessible, you can buy a Class A prefab chimney for about $75 to $100.

They're automatic. To start one of the new models, you simply drop in a load and set an automatic timer according to the type of waste. The wetter it is the longer it takes. Most loads are completely consumed in one to four hours.

At the end of the preset interval, the burner shuts itself off, so that it can be run unattended at any time during the day or night or when you're away. The fine ash that forms needs to be cleaned out only about once a week.

For safety, all gas incinerators have an automatic valve that shuts off the gas if the pilot light goes out. The makers also claim that they stay cold to the touch because of a heavy jacket of insulation, so there's no danger of burns to young children. Several models have treadle-operated doors that leave hands free.

To be sure of getting a good unit, see that it is clearly labeled "smokeless and odorless" and carries the AGA approval. Some new models are similar to the old ones on the outside—but not on the inside. —*A. M. Watkins.*

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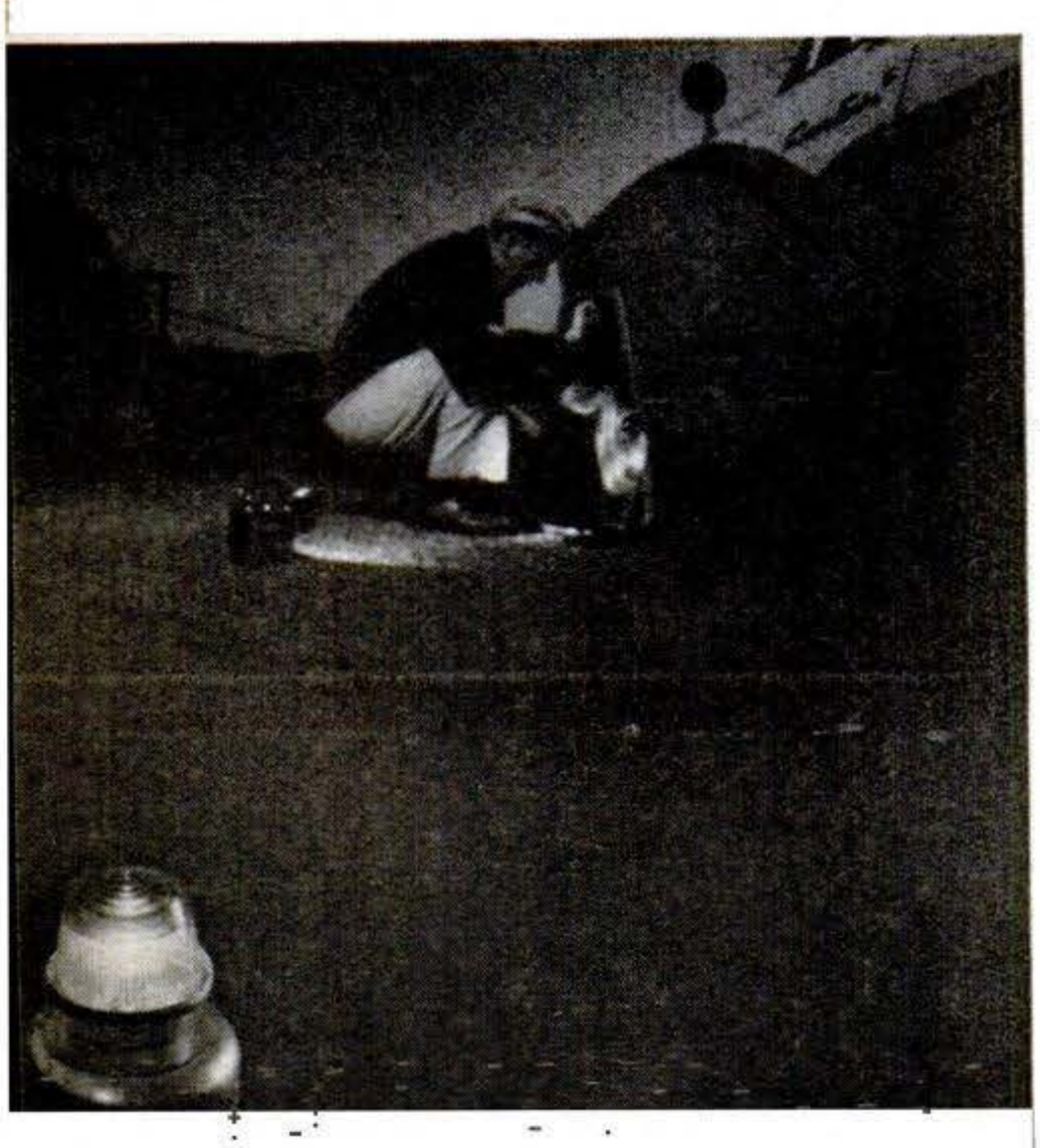
what's new

for your car

Nearest thing to radar for cars is ***an automatic parking alarm*** that sounds your horn whenever another car parks too close or when you have to "feel" your own way into a tight space. The projecting feeler, shown above, can be mounted on either the front or rear bumper and is connected by a single wire to your horn. Pressure on the feeler trips a switch that sets off a continuing blast until pressure is released. Product Associates sells the alarm for $14.95 . . . A "wraparound view" to match today's wraparound car windows is the aim of a ***wide-vision curved mirror*** that clips to your present rear-view mirror. The Sta-Dri accessory is 12″ long . . . If you don't go for the dash-mounted mirrors on some cars, Yankee Metal Products offers an ***overhead mirror bracket*** that lets you remount the mirror above the windshield . . . A new line of Koehler battery spotlights have an added safety feature: ***a flashing red extension light***, as shown at left. It plugs into the battery spotlight and can be placed up to 10 feet away to warn approaching motorists. The white spotlight has a half-mile range, adjustable focus, comes in three models for about $9 to $15 . . . A special ***muffler-sealing cement*** is available



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from the Magic Iron Cement Co. for patching rust leaks and loose joints . . . You don't have to move your car or jack it up to put on the ***quickly mounted tire chains*** at right. Two bent-wire arms built into the sides let you slip the chains up under the fender and over the wheel. Then you simply reach behind the wheel with a long hook to fasten the inside. The outside is latched in the conventional way, and spreaders pull the chains taut so the inner hook can't come undone. The Campbell chains come to fit all wheel sizes for about $15 to $18, and the maker even throws in a pair of plastic sleeve protectors.

Signs that summer isn't far off: ***Screens for car windows*** keep out bugs when you stop to camp, eat or catnap. Made by the Car Bed Co., they have self-adhering edges. You just press them on, or roll them up for storage in the glove compartment . . . If you like the sun and fresh air enough to spend $300 to $500, you can have a ***sliding roof*** installed in your car, station wagon (right) or even cabin boat. Two styles, metal and fabric, are made by Golde Body Parts, and you can even have your choice of manual or automatic electric operation . . . Less luxurious, but useful, is a ***car-wash mitt*** that keeps your hands dry while you wipe on the suds. It's sold by F.P.I., Inc. for $1.98 and has a pocket in the back that holds detergent powder.

for your leisure hours

Two new uses for small, disposable tanks of gas: One is a ***gas-fired percolator*** that assures hot coffee on camping trips. Made by Blu-Burn-R Products, it will perk up to 12 hours before you hook on a new tank . . . Another is a Kerr ***portable air horn,*** also powered by a disposable gas tank, that you can carry in a boat. Price: $9.95.

Prefab summer cabins are being offered by two makers. Pan-Abode puts out a log-cabin type with the claim that you can assemble it in as little as an hour, without any nails. The smallest of several sizes is 12′ by 17′ for $800. Arnold-Dain uses a system of 3′ wall panels for any size plan from small tool sheds and pool cabanas to large summer homes. Prices range from $350 to $1,000.

Two ***Sputnik-inspired items:*** A 45-r.p.m. record of the satellite's actual radio beep, available for $1 from Mooney-Rowan. There's also a ***satellite plotter,*** for $1.95 from Library of Science, that shows when the little moons will pass over any given spot for best viewing . . . A new ***all-transistor short-wave portable radio*** that works on nine ordinary flashlight batteries is made by Zenith for $250. A hinged handle snaps up to expose a 3′ telescoping antenna, and eight bands give a tuning range from 540 kc to 22.4 mc. A log chart lists foreign stations and the hours of best reception.

More new products on the next page

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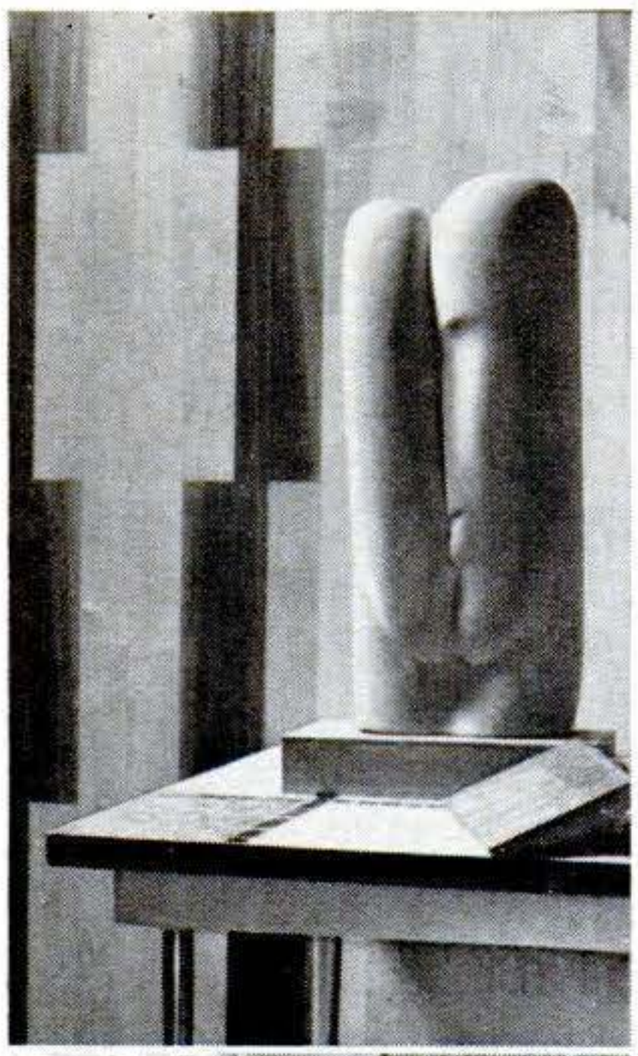
what's new for your home



Flooring that you can also use as wall paneling now comes in striking prematched patterns of contrasting hardwoods. The planks are 10′ and 12′ long for floors, 8′ for walls (left), so they span most rooms without the cutting and fitting of odd lengths. Made by Miller Brothers, they're also double standard flooring width to cut nailing time in half . . . ***Slimmer TV sets,*** only 10″ deep, are on the way from Sylvania. The trick? They let the flatter new 110° picture tube project 4″ out front to pare away still more cabinet depth.

Revolution in cooking utensils: Electric skillets, grills, griddles and pans now have a single, removable power control to cut cost and permit complete dunking in water for cleaning. Sunbeam, Dominion and Universal are among the trend-setters . . . Tappan's ***new counter-top range*** comes with a built-in motor that powers—count 'em—a food blender, mixer, meat grinder, fruit juicer and knife sharpener. Who says men have all the power tools? . . . Only thing that isn't self-powered is a ***non-motorized portable dishwasher*** (center, left) that uses faucet pressure alone to spin a rotating water spray. The 11-pound Chico unit is said to clean eating ware for a family of five in about six minutes. Price: $59.95 . . . ***Breath sweeteners for air conditioners*** are now available in the form of odor-trapping carbon filters that fit directly behind the dust filter. They're made in four standard dust-filter sizes by Conner Engineering . . . ***Inexpensive brick veneer*** can be made by pouring ordinary plaster-of-Paris into plastic molds (below, left). When hard, the "bricks" are put on with tile cement and painted (right). Two molds, for standard or Roman face-brick, are sold by the Official Decorator Mold Co. for $2.98.

for more information:

Here's where to write if you can't get any item listed above: **R. W. Anderson Co.,** *1110 W. 68th St., Los Angeles 44;* **Arnold-Dain Corp.,** *Rt. 6, Mahopac, N. Y.;* **Blu-Burn-R Products,** *Highway 69 S., Monroe, Wis.;* **Campbell Chain Co.,** *York, Pa.;* **Car Bed Co.,** *P. O. Box 213, Panama City, Fla.;* **Chico General Products,** *525 Market St., San Francisco;* **Conner Engineering Corp.,** *Danbury, Conn.;* **Diamond Expansion Bolt Co.,** *500 North Ave., Garwood, N. J.;* **Dominion Electric Corp.,** *Mansfield, Ohio;* **F.P.I., Inc.,** *336 3rd Ave., NYC 10;* **Golde Body Parts,** *6636 Charlevoix Ave., Detroit;* **Kerr Chemicals,** *P. O. Box 89, Park Ridge, Ill.;* **Koehler Mfg. Co.,** *Marlborough, Mass.;* **Library of Science,** *59 4th Ave., NYC 3;* **Magic Iron Cement Co.,** *5403 Bower Ave., Cleveland;* **Masterline Products,** *6715 Hollywood Blvd.,*

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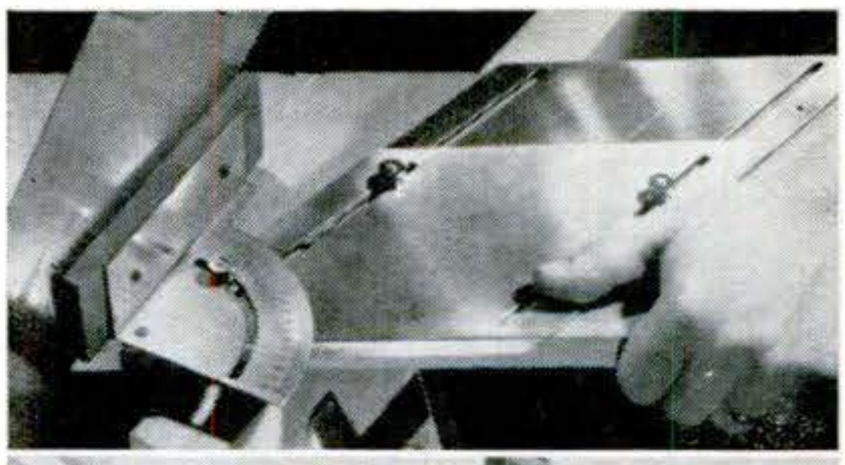
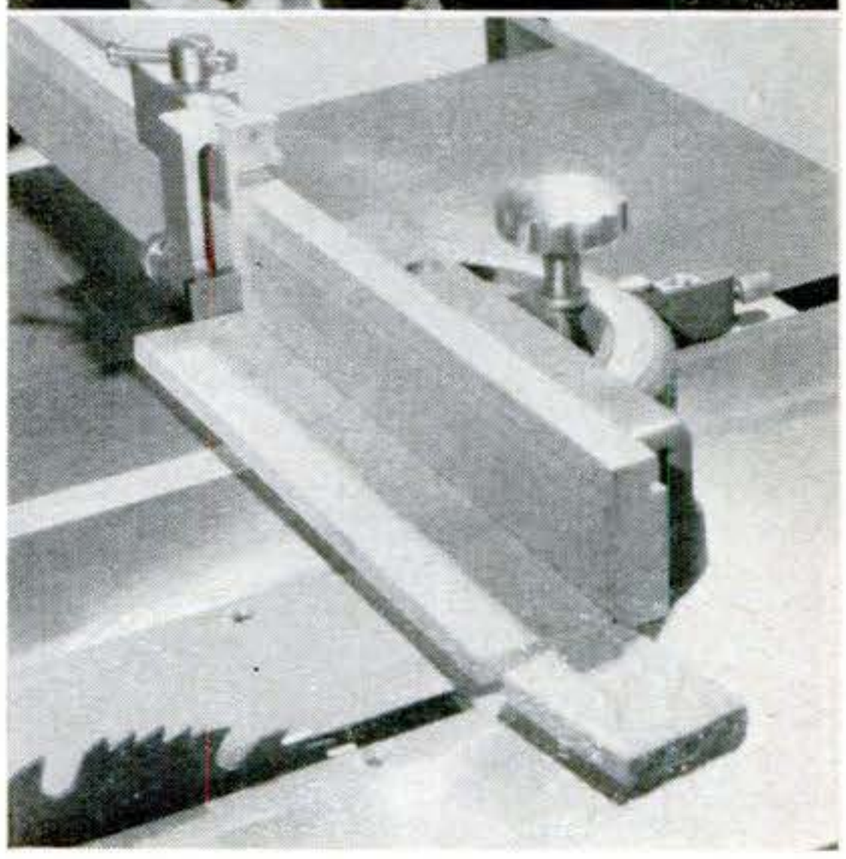
for the home shop

You can clamp a ***new miter guide*** right to the board you're sawing by adjusting two sliding plates. The Twix guide can be set to any angle up to 45° in both directions, fits all stock up to 8″ wide, and sells for $2 . . . ***A built-in wire stripper*** now comes on Wirestripper screwdrivers. You just pull a wire through a hole in the handle to remove the insulation.

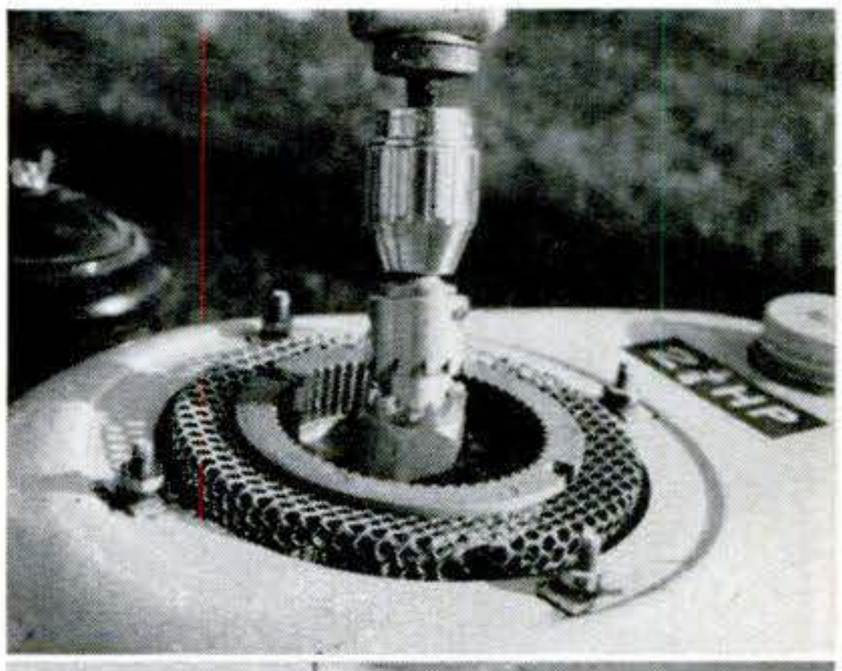


Interchangeable jaws for pliers let you set or remove rivets, crimp metal and punch holes. They're made by Time Saver Tools in many types to fit cam-action pliers . . . Critical saw settings are quickly made with an ***adjustable table-saw stop*** that slides on a rail fastened to the miter gauge. You first lock the stop in approximate position, then adjust a screw feed for pinpoint accuracy. The stop swings up out of the way without disturbing the setting. R. W. Anderson sells it for $3.50.



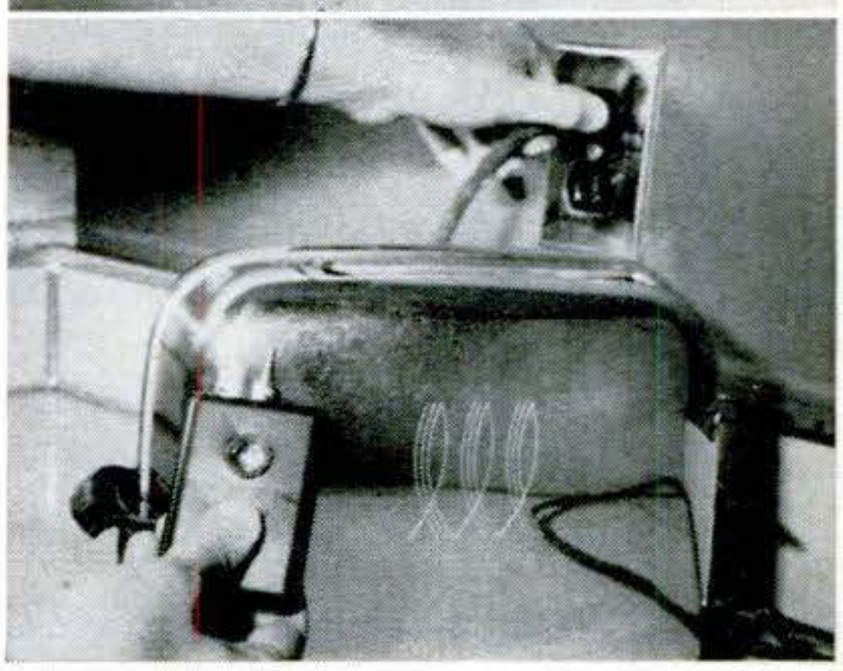
for the home handyman

You can start a power mower with an ***electric-drill attachment*** sold by Rotex. A toothed cylinder, chucked in the drill, spins a matching toothed nut screwed permanently to the mower's shaft. As the mower picks up speed, the drill is automatically disengaged by a ratchet action . . . It had to come: ***A four-color ball-point pen*** for $4 by Masterline.



Two extra-short expansion anchors, made by Diamond and by Molly, are designed to attach things to hollow-core doors and over narrow furring strips where space is shallow . . . A new Plug-Rite ***neon tester*** tells instantly whether an appliance, radio or power tool is correctly plugged in, to avoid a "hot chassis" that can cause shocks. If the light glows, you reverse the plug in the wall . . . For the handywoman: ***pre-measured soap packets*** by Reynolds Metals. Toss 'em in a washer—the packets dissolve.

Sheldon Gallager



Hollywood, Calif.; **Miller Brothers Co.,** *Johnson City, Tenn.;* **Molly Corp.,** *Reading, Pa.;* **Mooney-Rowan Publications,** *Severna Park, Md.;* **Official Decorator Mold Co.,** *96 Flamingo Rd., Levittown, N. Y.;* **Pan-Abode, Inc.,** *Kennydale, Wash.;* **Plug-Rite Inc.,** *3232 Olive St., St. Louis, Mo.;* **Product Associates,** *1046 S. Olive, Los Angeles;* **Reynolds Metals Co.,** *3842 Georgia St., Gary, Ind.;* **Rotex Sales Co.,** *8305 Sovereign Row, Dallas, Tex.;* **Sta-Dri Products,** *147-47 6th Ave., Whitestone, N. Y.;* **Sunbeam Corp.,** *5600 Roosevelt Rd., Chicago;* **Sylvania Electric Products,** *1740 Broadway, NYC 19;* **Tappan Stove Co.,** *Mansfield, Ohio;* **Time Saver Tool Corp.,** *7116 Madison Ave., Hammond, Ind.;* **Twix Mfg. Co.,** *40-09 21st St., Long Island City, N. Y.;* **(Universal) Landers, Frary & Clark,** *New Britain, Conn.;* **Wirestripper Tools, Inc.,** *Glen Head, N. Y.;* **Yankee Metal Products,** *Norwalk, Conn.;* **Zenith Radio Corp.,** *Chicago.*

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Pick one you like, and build it in one evening:

4 Bargain Tables from Flush Doors

By Darrell Huff

THE advantages of making a dining or coffee table from a flush door have multiplied as the prices of these handsome doors have dwindled.

You can put together any of the four smart tables shown, using a hollow-core door, in an evening. The door will cost as little as $6 to $10 in colorful Philippine mahogany, perhaps 50 percent more in blond birch. Add a few dollars for underpinnings and edging—and you have a really big table at a bargain price.

Home and Shop

The designs are easily modified in height. Make a dining table or writing desk 28″ to 30″ high, typewriter desk 26″, coffee table about 15″. Choose a door 36″ wide if you're making a dining table, one anywhere from a width of 24″ up for a coffee table, serving table or desk.

Nearly all doors are 80″ long. You can trim one down for a shorter table. Or you can cut it into two or three pieces for a set of small tables.

For a utility or outdoor table, or one to be enameled, you may find a door made with hardboard surfaces for $3 or $4. A door with one side scratched or gouged is often available at a bargain—and who sees the underside of a table?

Directions for making legs for the tables shown are based on using a select grade of construction lumber from the lumberyard. If you make them of hardwood instead, you can reduce these dimensions slightly. For instance, instead of two-by-fours use hardwood about 1½″ by 3½″.

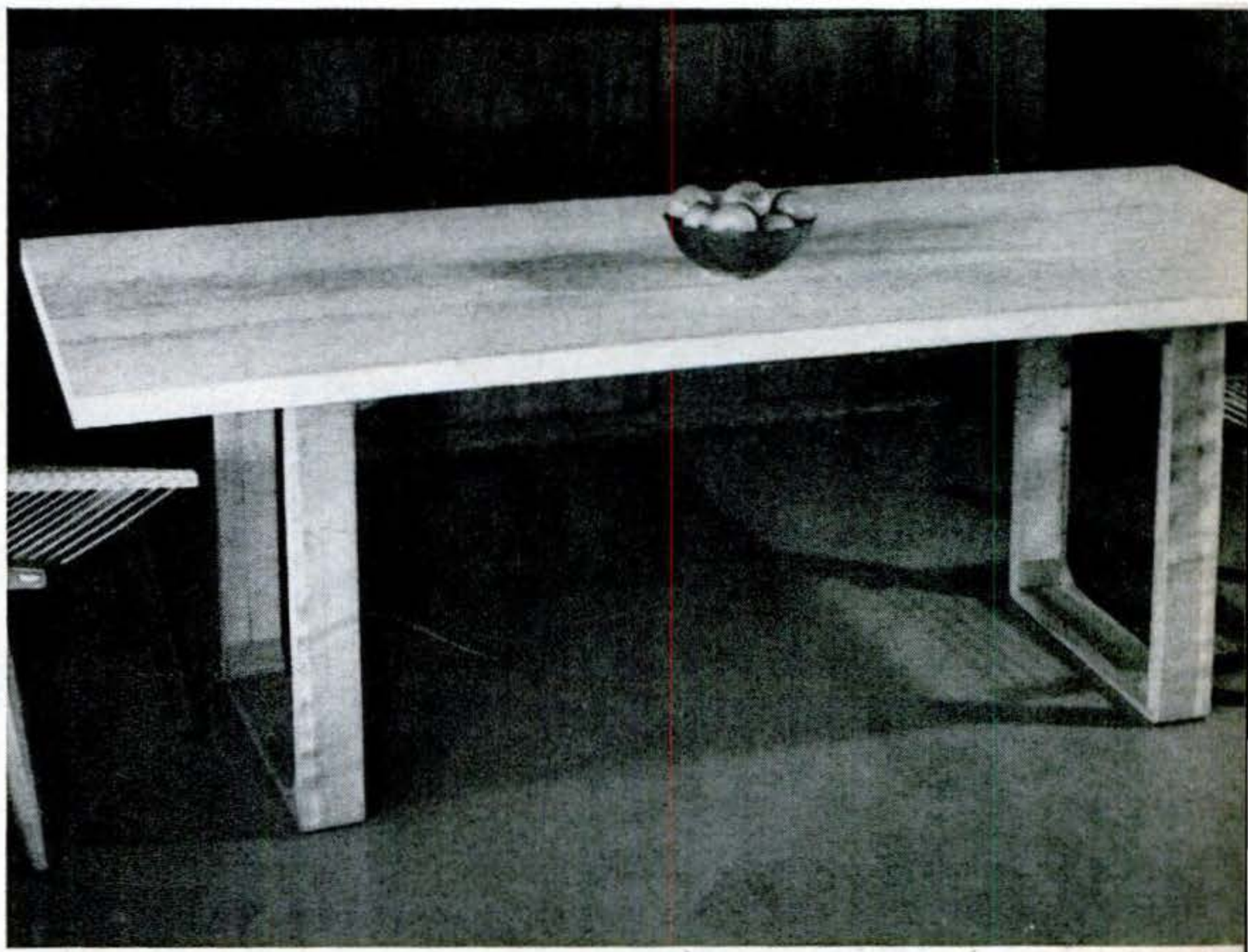
A clear finish will preserve the natural beauty of the attractive woods used in

1. Early-American Trestle

Combining modern simplicity with traditional shape and construction, this big table uses the full expanse of a 36″-by-80″ flush door for roomy dining.

2. Splay-Leg Table

Each pair of legs is taper-ripped from a single piece of standard lumber. The taper gives a neat, slanted effect without the use of angle mounts.



3. Hollow-Square Table

A pair of open square frames support this attractive dining table and provide solid cross braces. Wedge-shaped corner blocks reinforce the two frames.

4. V-Leg Table

This simple plan enables you to build a table in an hour or so. The legs are made by joining two pieces of lumber to form a V-shaped trough.

For construction details, see the next three pages

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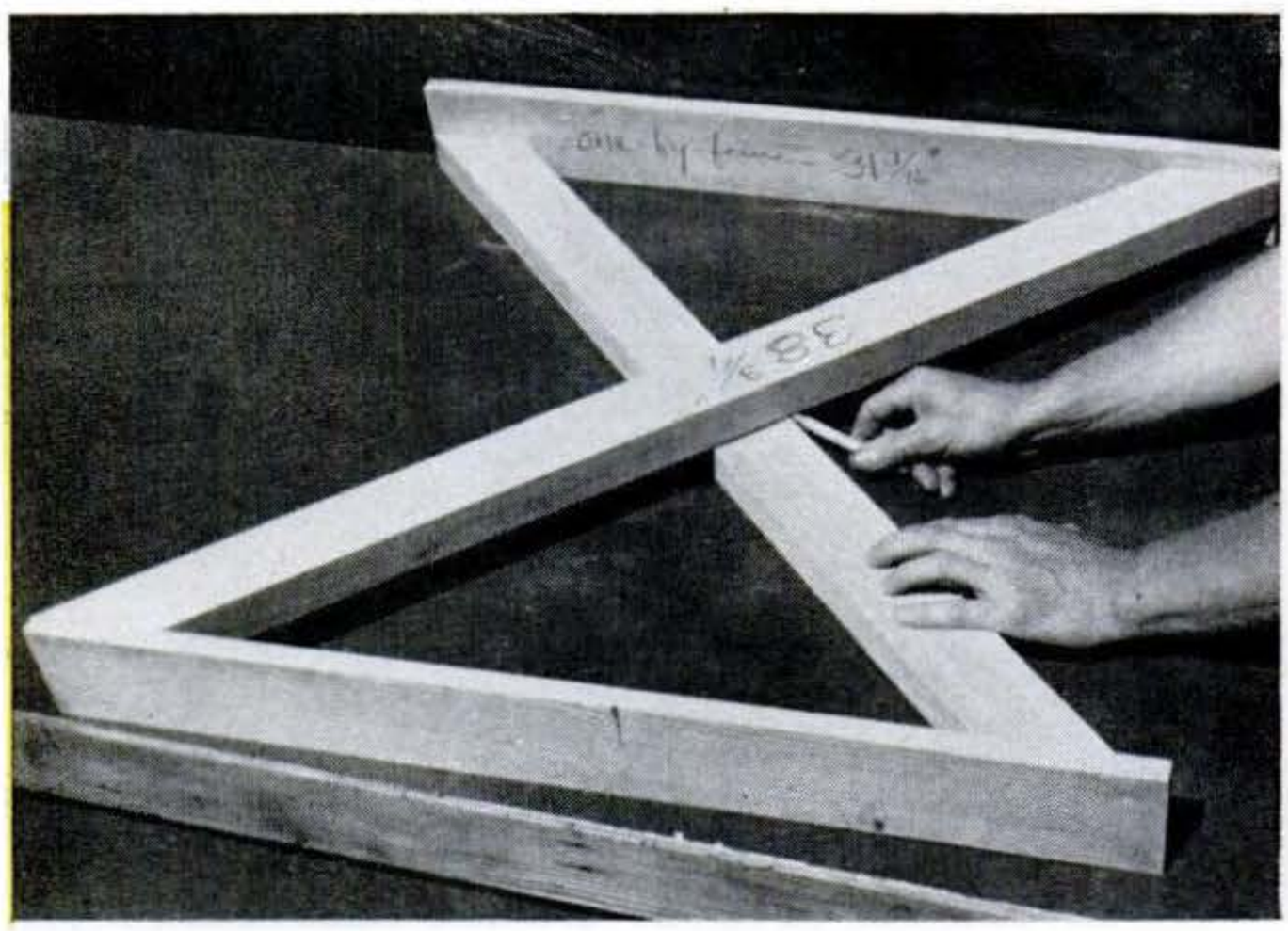
1.

Materials for the Early-American Trestle

36″ x 80″ door
14′ of 2″ x 3″ lumber
6′ of 1″ x 4″ lumber
4′ closet pole, 1″-1½″ dia.
4 No. 8 oval-head screws, 1¼″
16 No. 8 flathead screws, 1½″

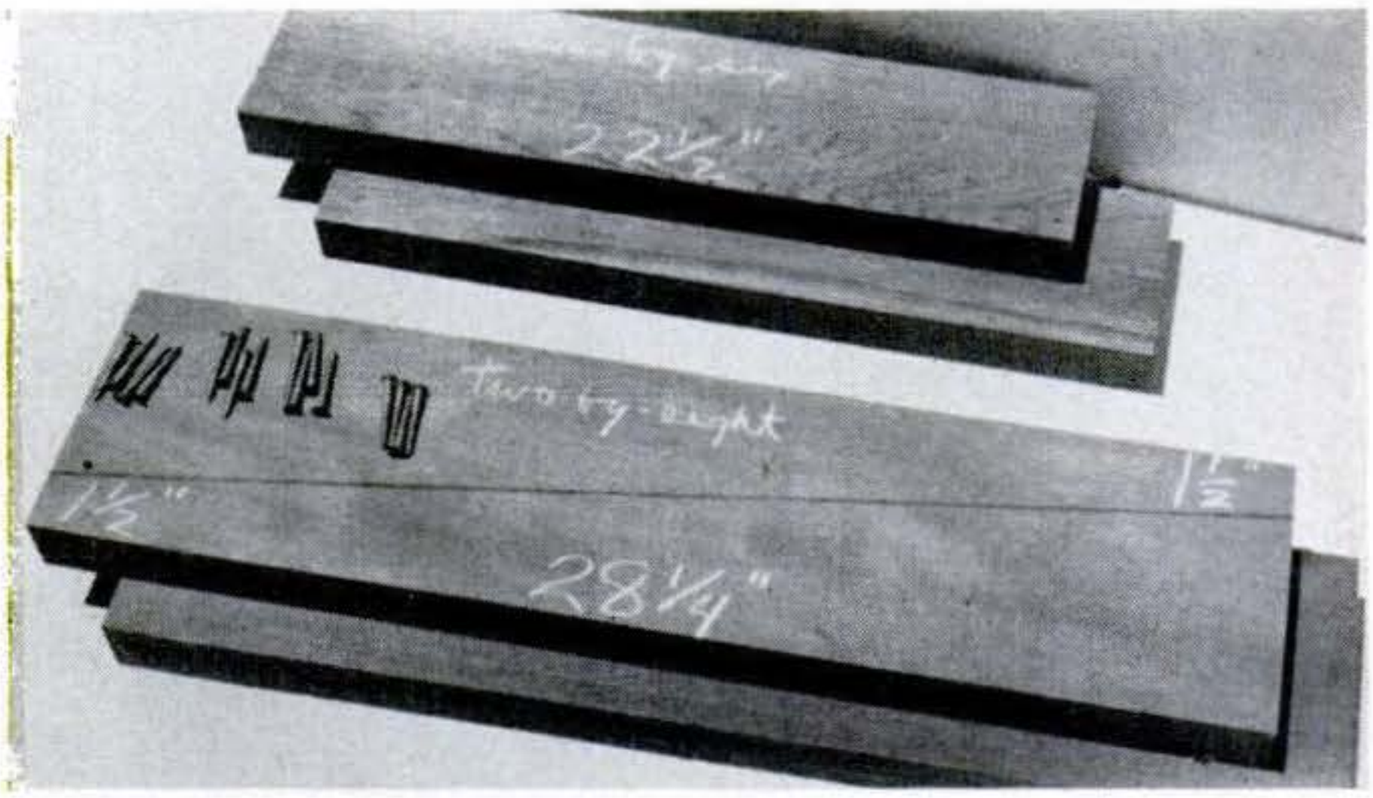


CUT four 38¾″ legs with 45° ends from two-by-three; two 31 3/16″ braces from one-by-four. Cross legs between braces, mark half-laps and cut them. Bore each *inner* leg for pole.

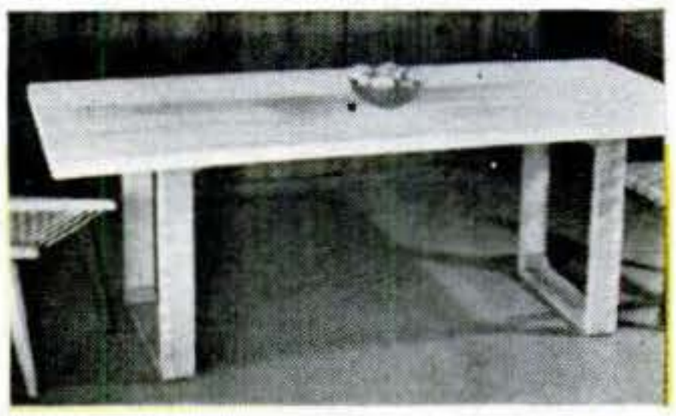
2.

Materials for the Splay-Leg Table

36″ x 80″ door
5′ of 2″ x 8″ lumber
4′ of 2″ x 6″ lumber
16 No. 12 flathead screws, 2″



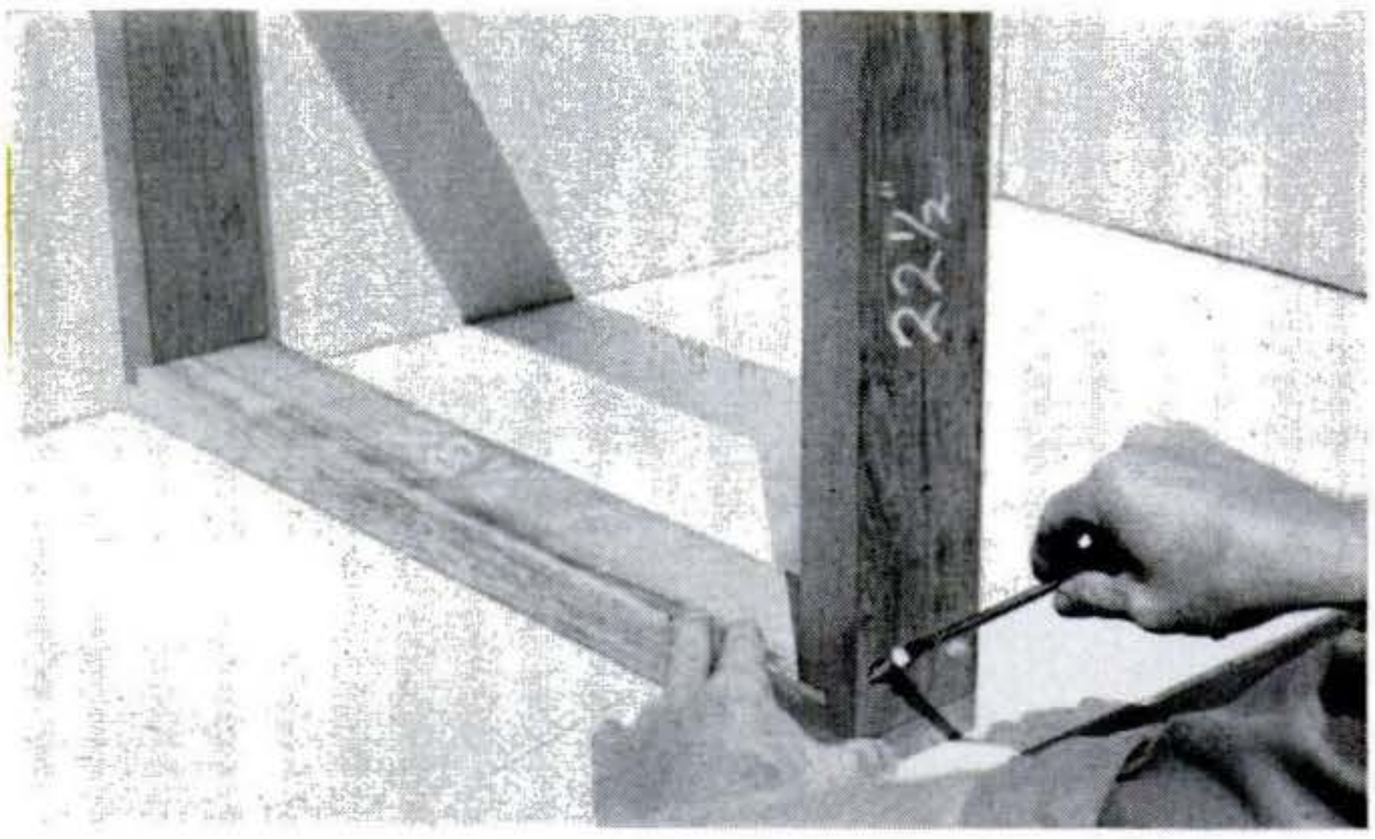
CUT the two-by-six into two 22½″ crossbraces. Saw each two-by-eight into two 28½″ pieces and draw a diagonal line ending 1½″ from opposite corners. Rip along this line to make legs.



3.

Materials for the Hollow-Square Table

36″ x 80″ door
2 lengths, 10′ each, 2″ x 4″ lumber
28 No. 12 flathead screws, 2″



CUT each two-by-four into two 22½″ lengths and two 28½″ lengths. Rabbet all ends and make two identical rectangular frames, using glue and two screws at each rabbeted corner.

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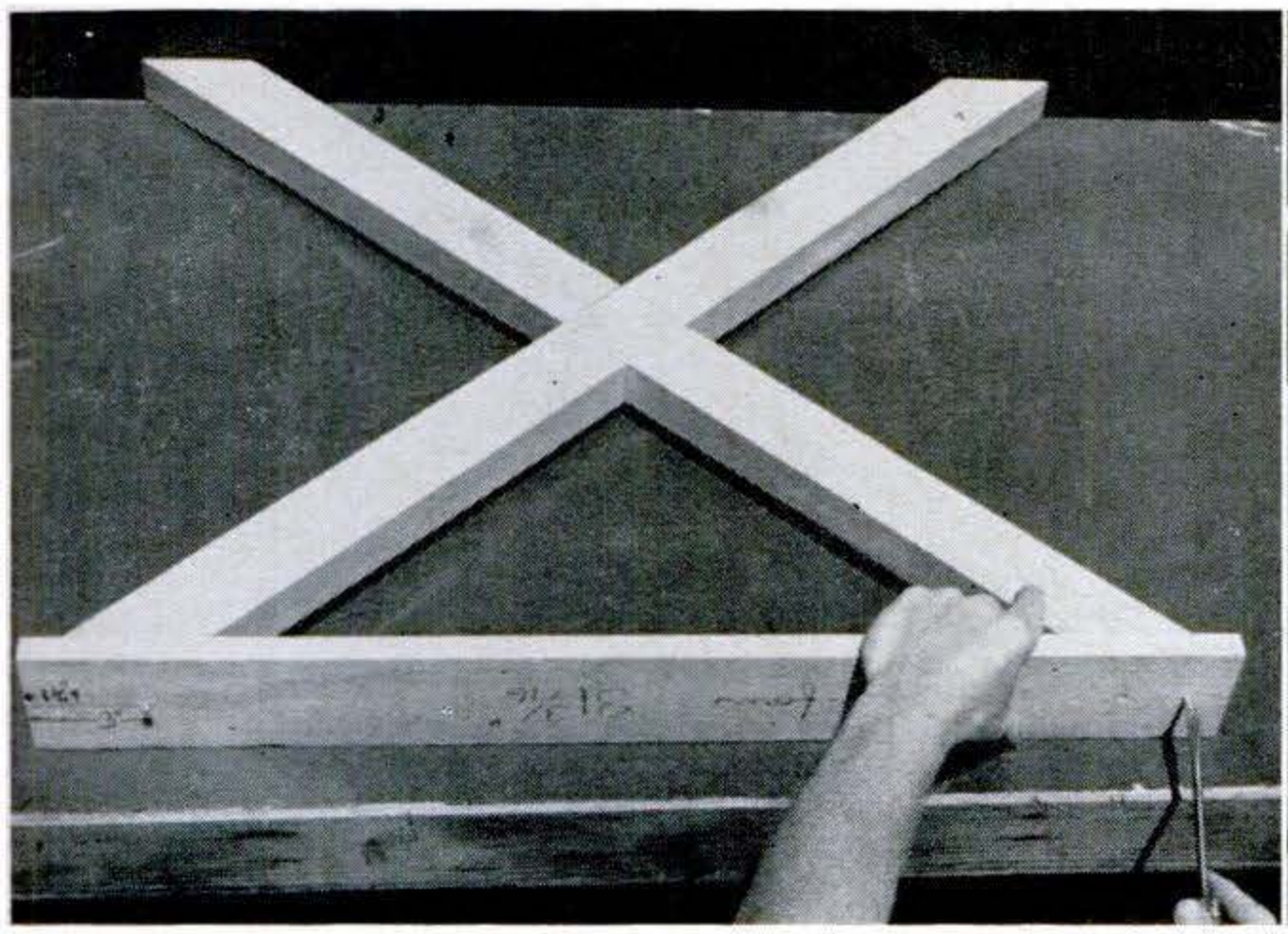
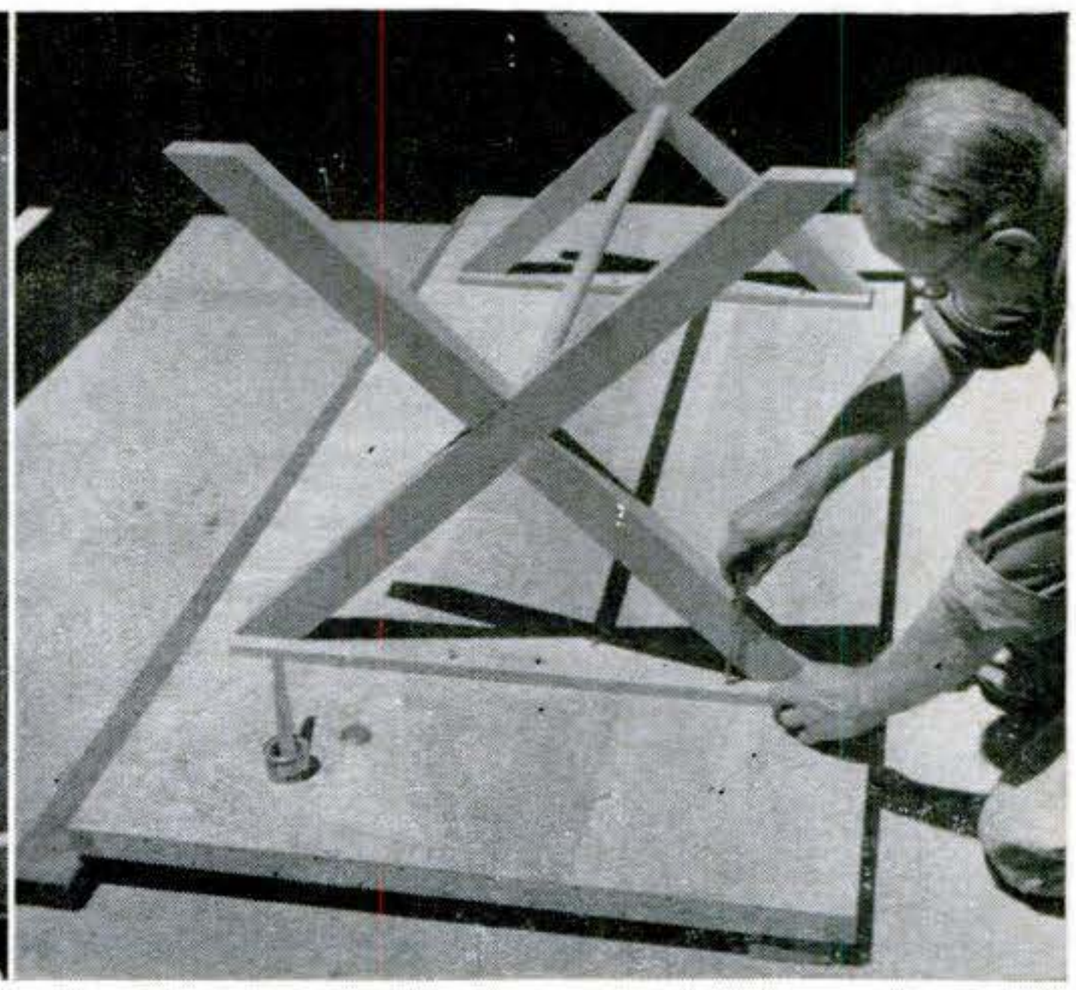
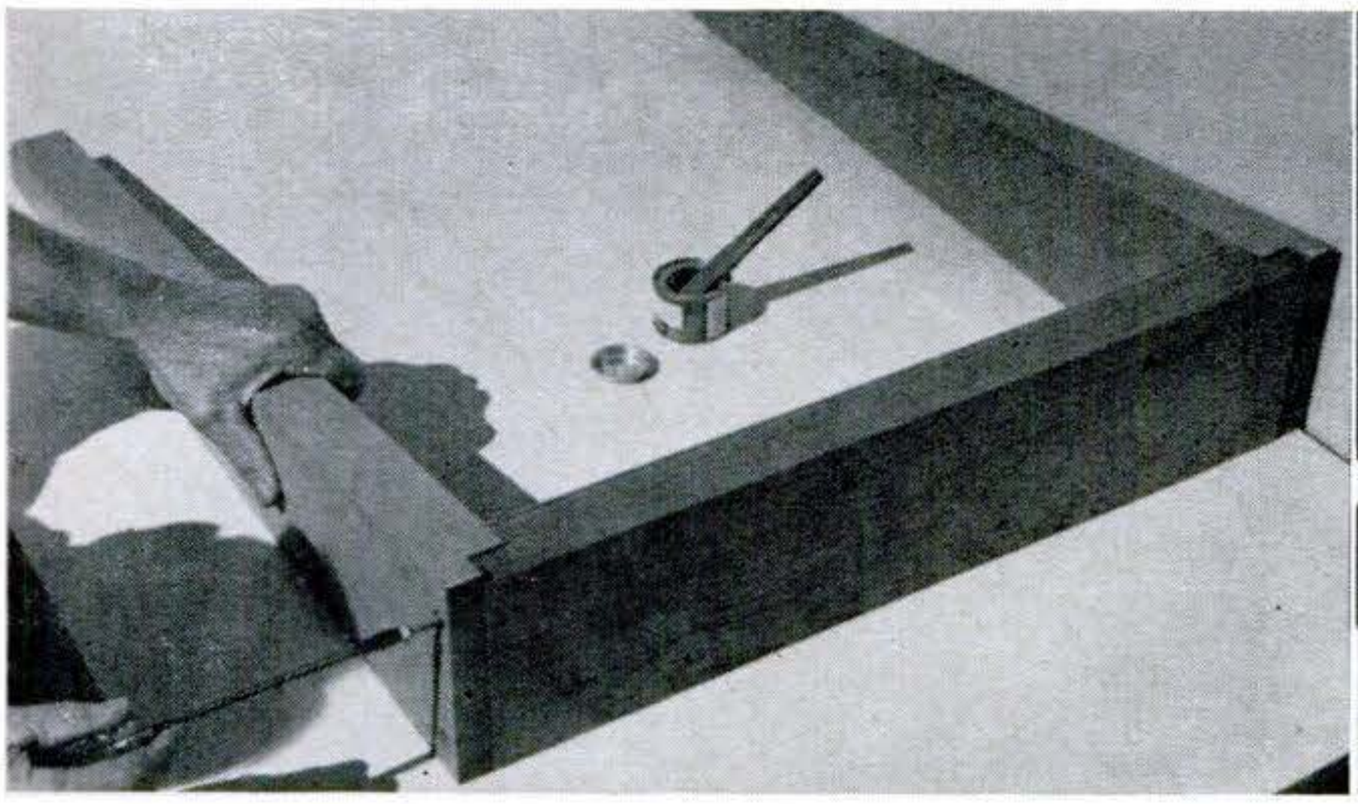


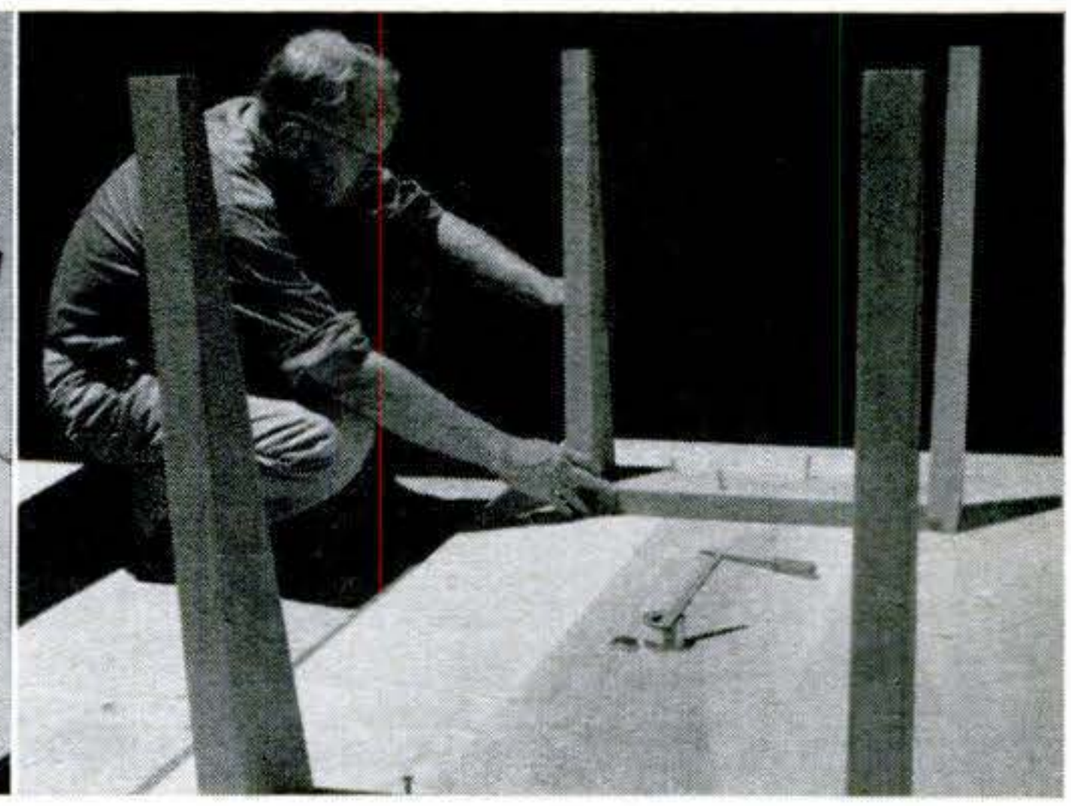
FIT half-lapped legs to crossbraces and fasten the top ends with glue and 1½" flathead screws to make trestles. *Then* secure the lap joints with glue and 1¼" oval-head screws.



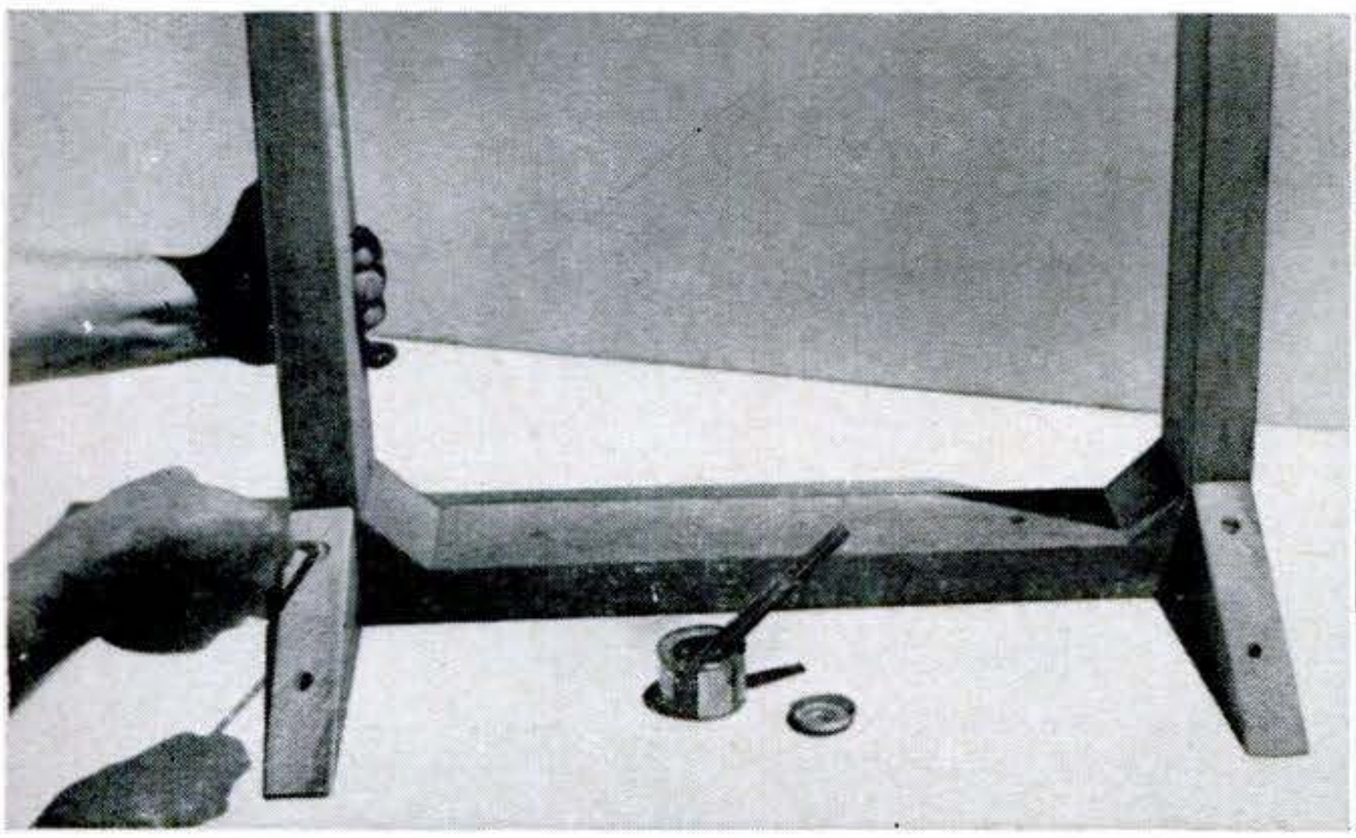
ASSEMBLE the trestles to the underside of the door after gluing the pole between them. Drill four holes for screws in each crossbrace, spread glue on meeting surfaces and fasten.



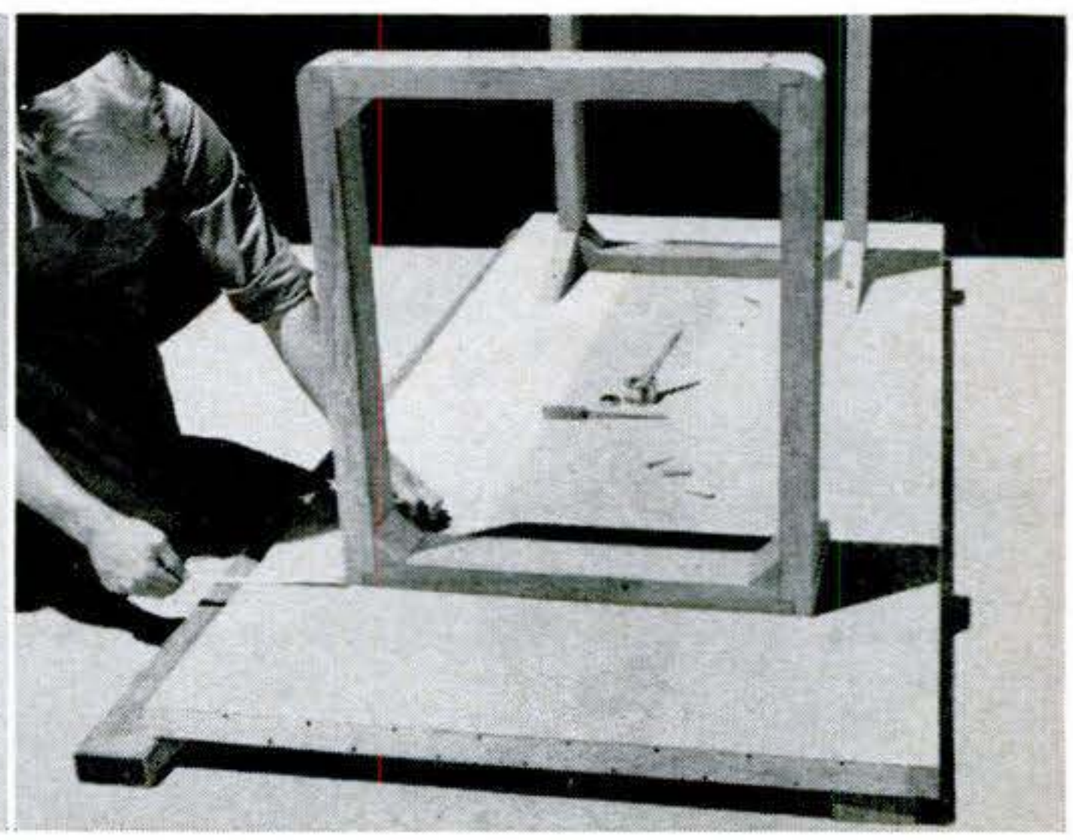
FIT rabbets cut in the upper leg ends to matching rabbets cut in the crossbraces, and fasten them with glue and two screws at each joint. Countersink the screw heads in the legs.



ASSEMBLE the table. Place the legs 12" to 16" from the ends of the door, square across it and an equal distance from both edges. Fasten each brace with glue and four screws.



FIT two triangular blocks cut from leftover two-by-four and glue them to the inside corners of the frames. Drive one screw through each triangle to pull it up against the frame.



ASSEMBLE the frames to the door with glue and four screws. Screws alone would not hold in the thin veneer. Round off the bottom of each square as shown. (Please turn the page.)

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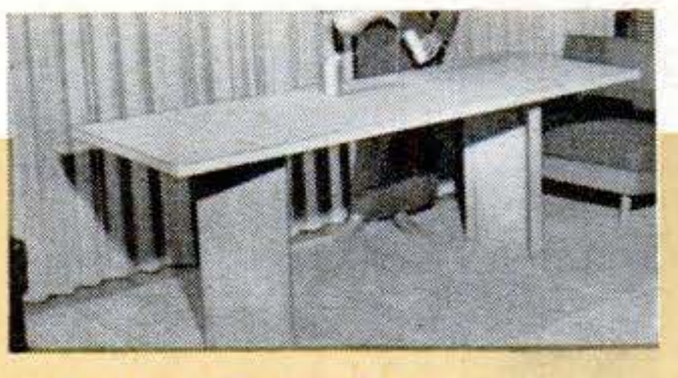
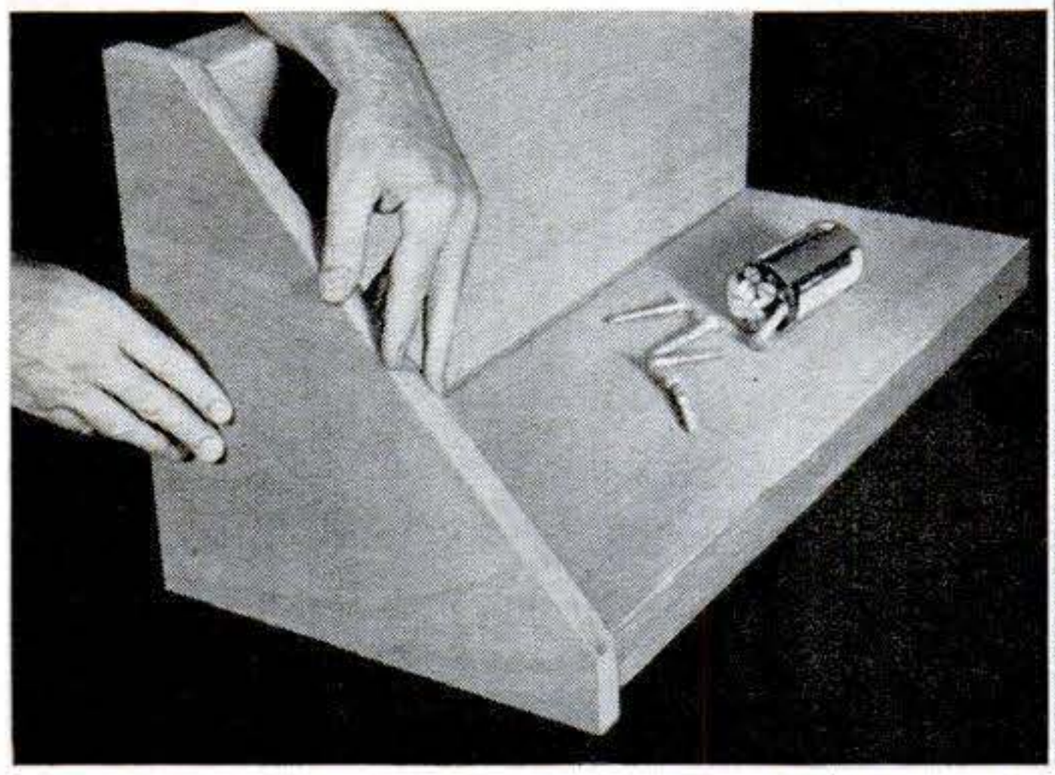


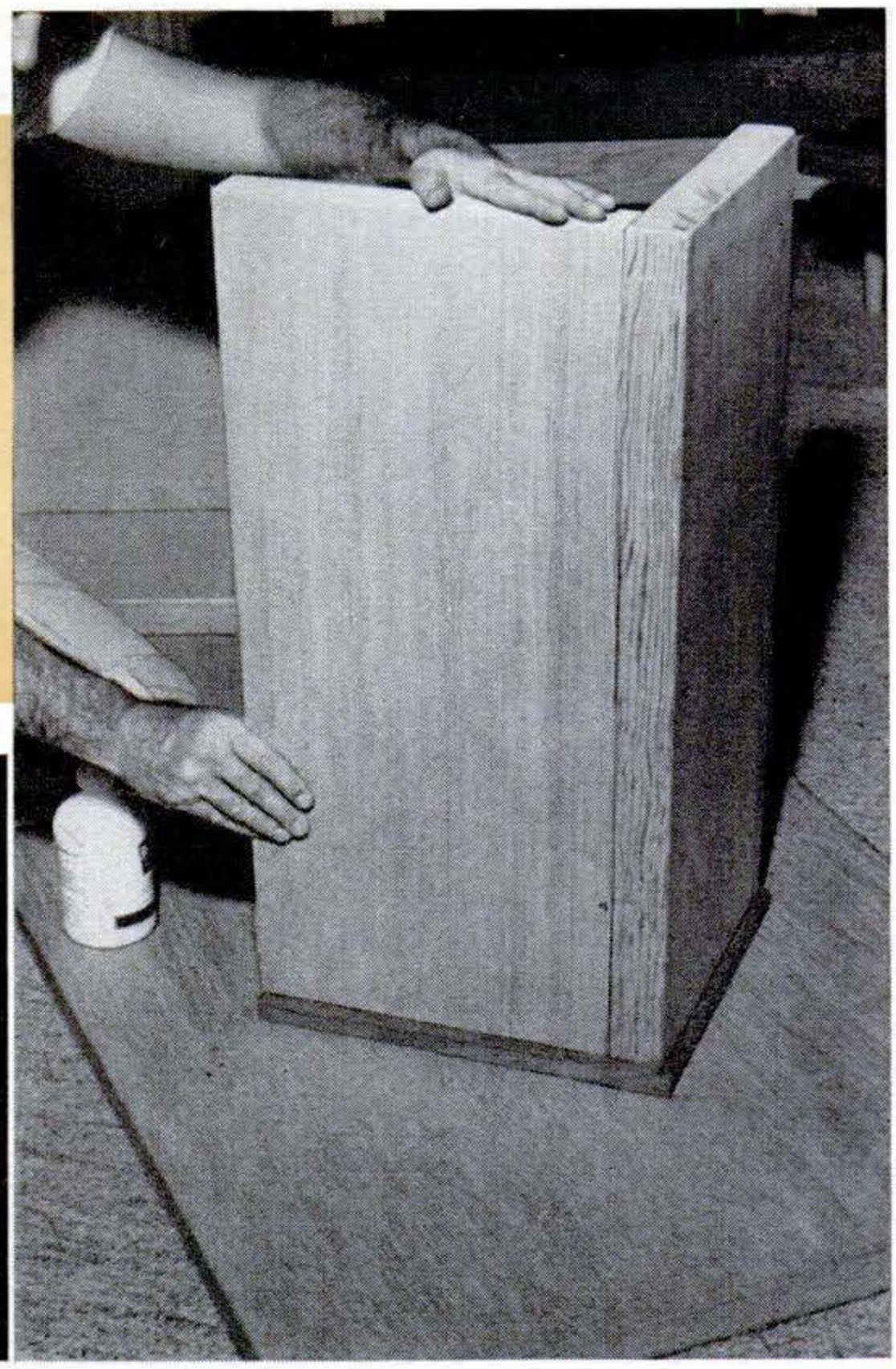
4.

Materials for the V-Leg Table

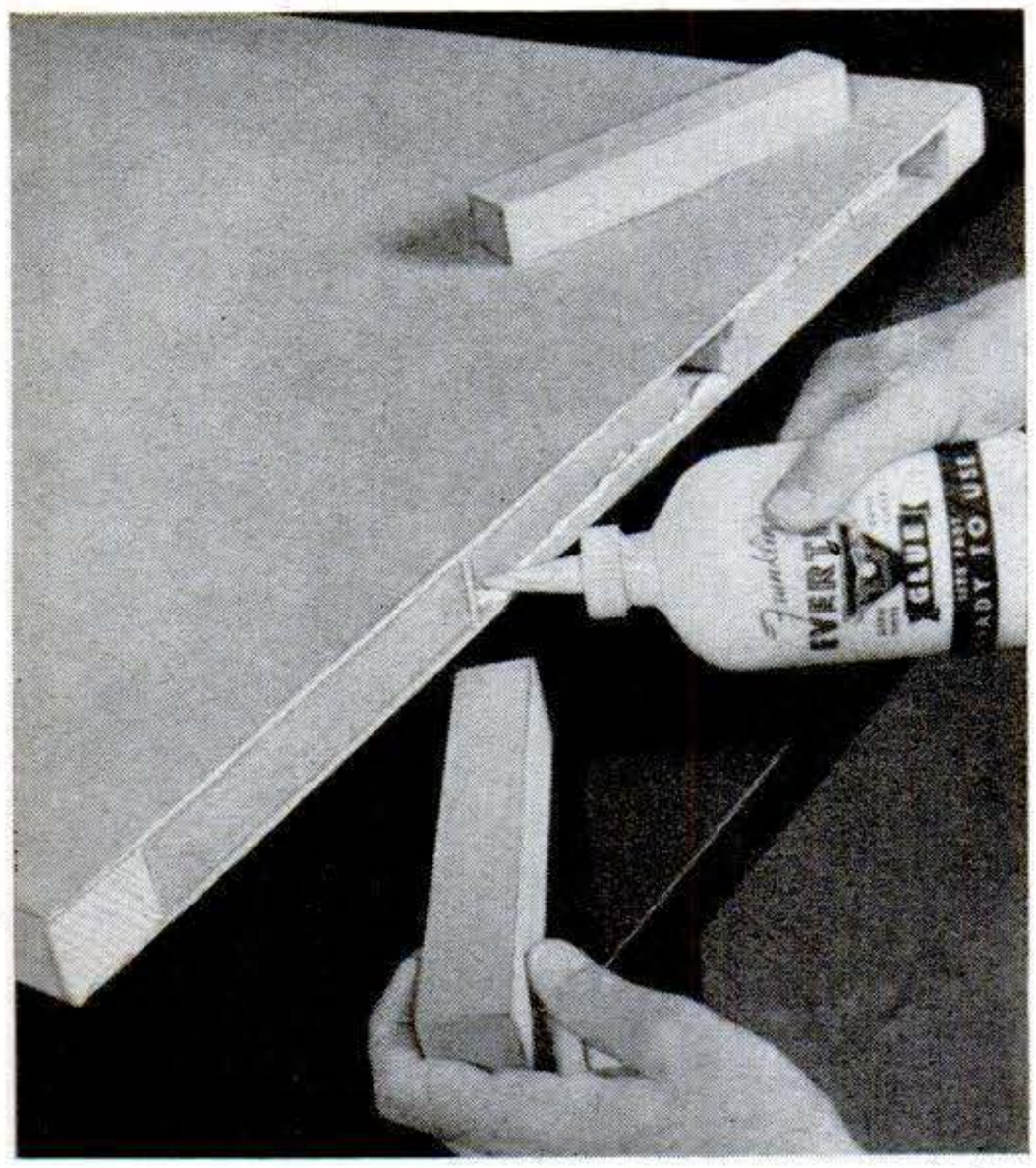
36″ x 80″ door
10′ of 2″ x 12″ softwood (only 5′ for 15″-high coffee table)
12″ x 14″ piece of 1″ lumber



CUT the two-by-twelve into four 28″ lengths and rip 1⅝″ off two of them to make two troughs with equal sides when butted. Saw diagonally across the 1″ lumber for the triangles.



FIT a triangle to one end of each trough and glue it. When dry, center the troughs 8″ from the door's ends and glue them. Pile on books to apply pressure while the glue sets.



FLUSH DOORS sawed in two to make similar tables, probably will have open space at ends. Fill these by cutting blocks of scrap lumber and gluing them flush with the veneer edges.

flush doors. One of the wipe-on sealers can be applied so quickly with a soft cloth that you really can finish your table in a single evening—and use it the next morning.

How to cut a flush door. When you saw a flush door in two to make smaller tables, the cut ends will probably have open hollows. Fill them by cutting blocks from scrap lumber and gluing them in flush with the veneer surfaces. Plane them smooth after the glue dries.

If you're building a table to grace your dining or living room, you'll probably want to conceal the lumber edges of the door with strips of matching veneer, now widely available in lumberyards.

To apply the veneer, brush a coat of contact cement onto the edge of the door and the veneer strip. Let the cement dry 30 minutes, apply another coat and let it dry 30 minutes. Place the veneer exactly in position and press firmly. Trim flush with a plane and sanding block. **END**

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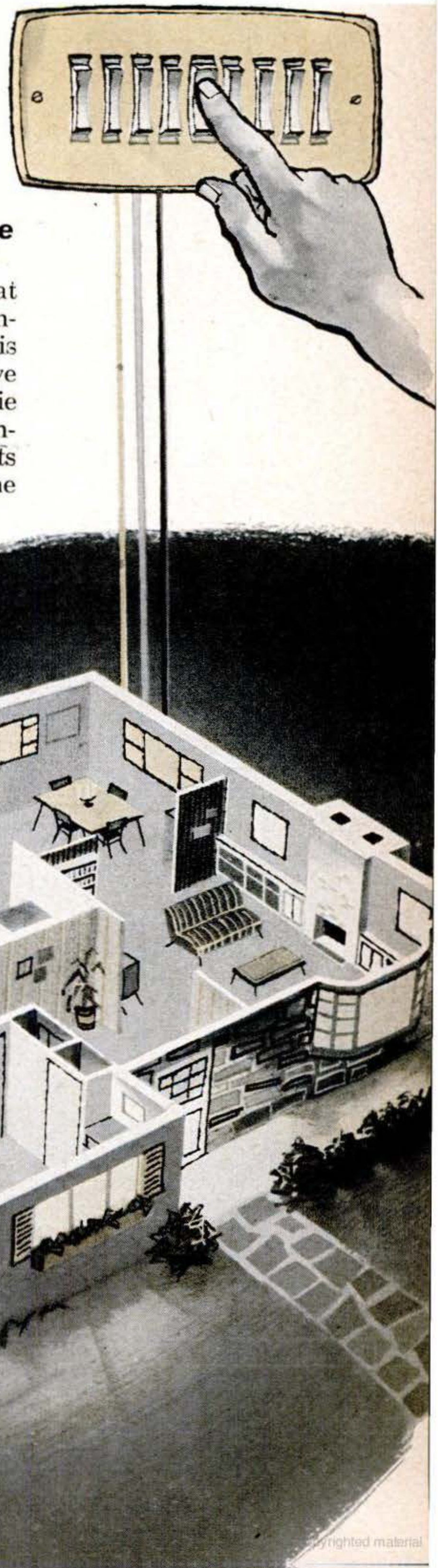
How to Light Your Home with Remote Switches



Simple relays put you in control of lights and appliances from any part of the house

REMOTE switching—the house-wiring system that puts any number of electric circuits under your control from as many switch locations as you wish—is well past the luxury stage. Today you can buy inexpensive and easy-to-install components for such a system and tie them into your present 115-volt circuits. Once they're installed, trim little relays will open or close these circuits whenever you nudge them with a shot of 24-volt juice. The

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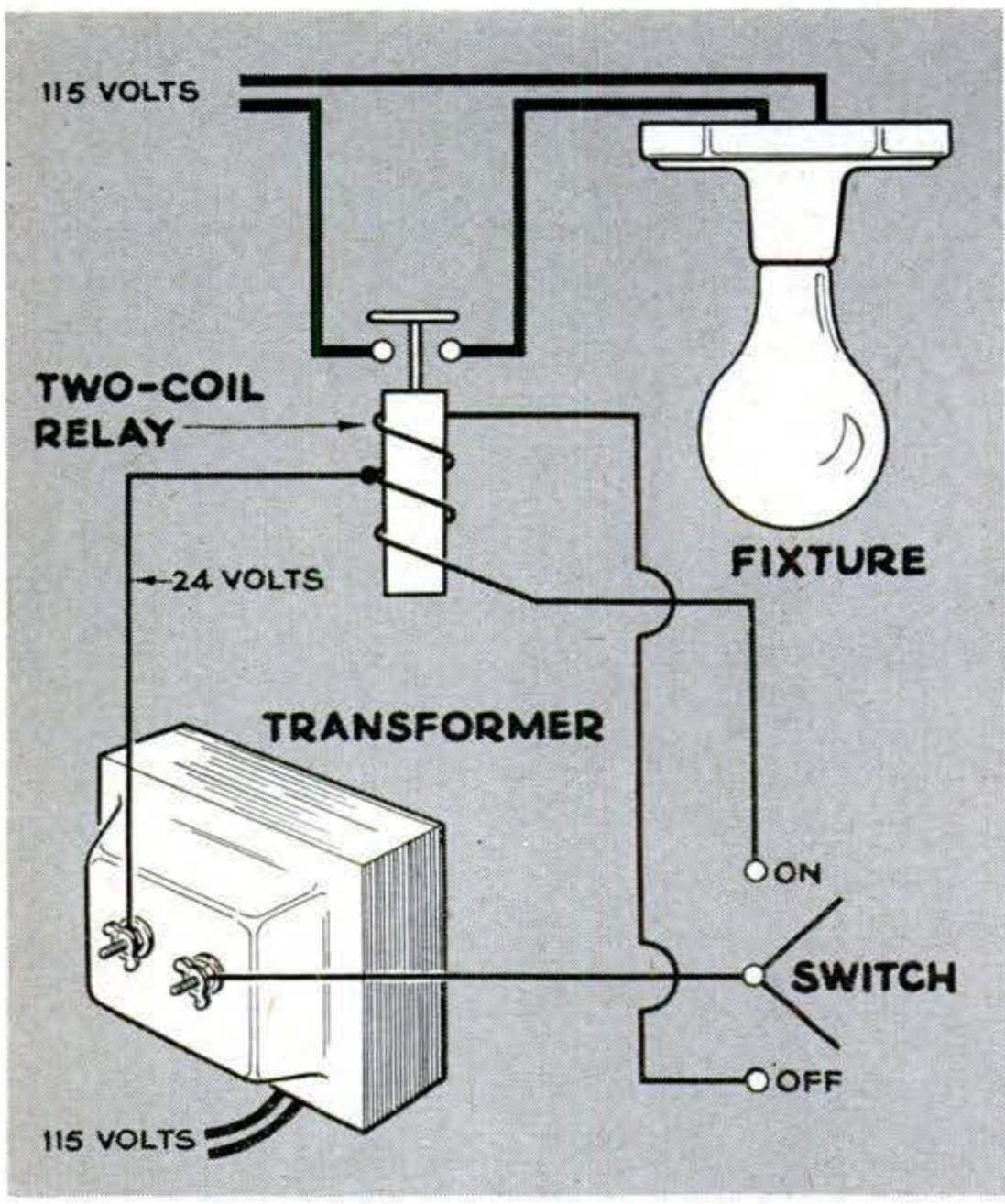
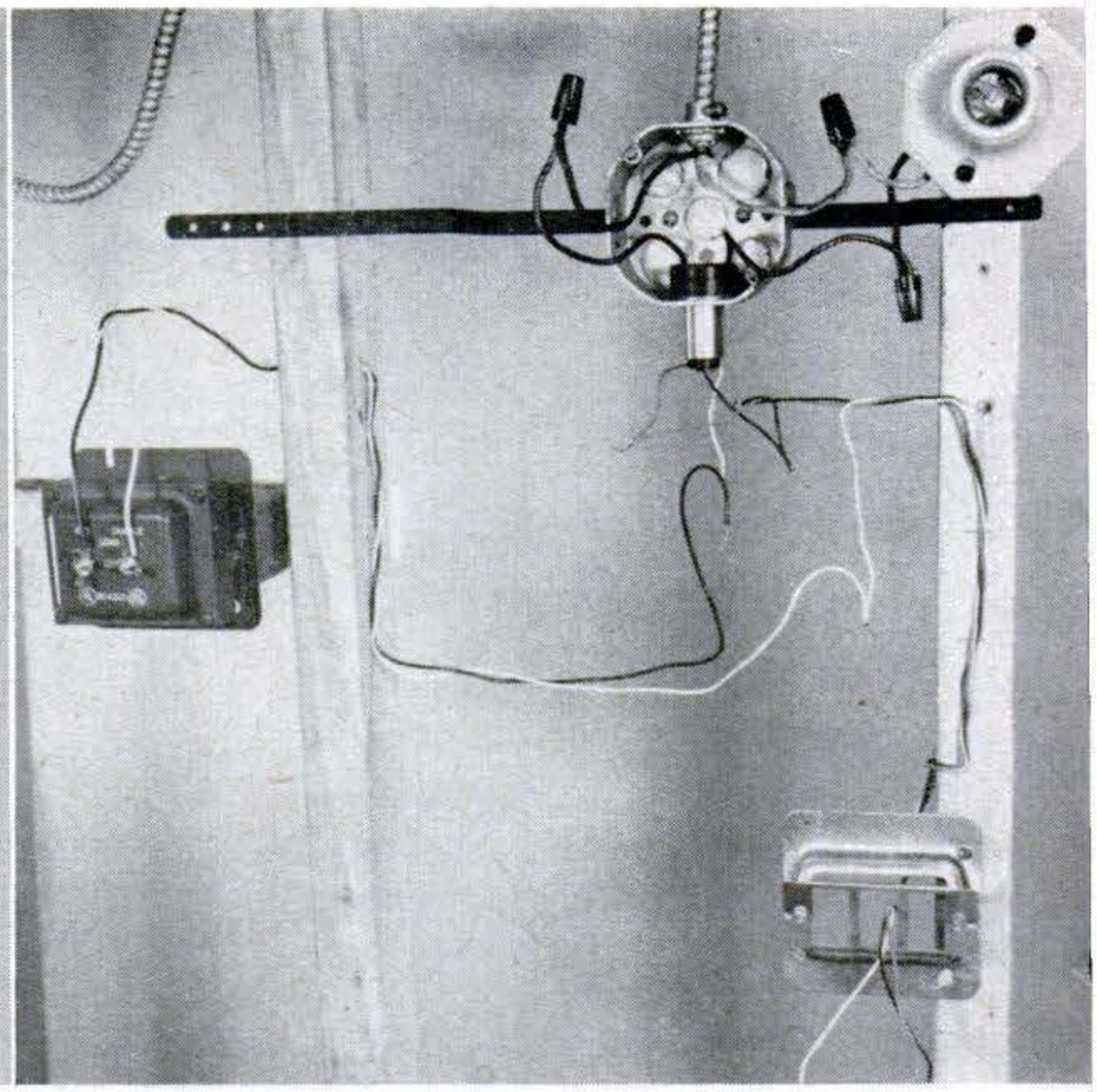
Basic multiple-switching hookups



REMOTE-SWITCHING CIRCUIT is shown above in schematic drawing. A transformer supplies the 24-volt current needed to operate a two-coil relay which opens or closes a 115-volt house circuit, depending upon which coil is energized by a two-position, momentary wall switch.



OUTLET-MOUNTED RELAY MOCK-UP. Here, each circuit-opening and -closing relay is set in the outlet box of one of the fixtures it controls. In most home installations of this type, a single transformer does the job, supplying low-voltage current for all of the relays in the house.

systems are amazingly versatile—you'll find many ways to use them.

If you go for a complete house installation, you'll have a central control station, usually located in your bedroom, from which you can open and close any one of eight independent circuits, or all eight simultaneously. One circuit might floodlight your yard, illuminate a post lamp, and turn on the porch lights. Another might project a path of lights from your front hall through the living and dining rooms to the kitchen. A third and fourth could determine the lighting level in the living room—one by turning on a pleasing arrangement of table and bridge lamps; the other, by cutting in the overheads and wall fixtures.

This central control station—a checker-upper that lets you douse the last of the lights when you go to bed, or flood your home with illumination in an emergency—is only part of the deal.

There's no limit to the number of control stations you can have. For that path of light between the front hall and kitchen, for example, you'd place other control switches close to the front and back doors, and at one or two intermediate spots.

What makes this modern switching system so flexible is its use of secondary, low-voltage circuits to operate relays that open and close the 115-volt light and appliance circuits. Its basic parts are: (1) a *transformer*, which reduces ordinary house current to the low-voltage juice that operates the relays; (2) a *two-coil relay* for each 115-volt circuit; (3) a *two-position, momentary switch* at each control station; and (4) *low-voltage conductor wires* to deliver the output of the transformer, through the switches, to the relays.

Transformer. With a single exception, the manufacturers of remote-switching systems use one 24-volt transformer to energize all of the relays in a complete house installation. This transformer can be mounted in a standard 4″-square box, with its 115-volt pigtail wires spliced directly to a house circuit. On the low-voltage side, one of its pigtails is connected to wires going to the wall switches; the other, to wires leading to the relays.

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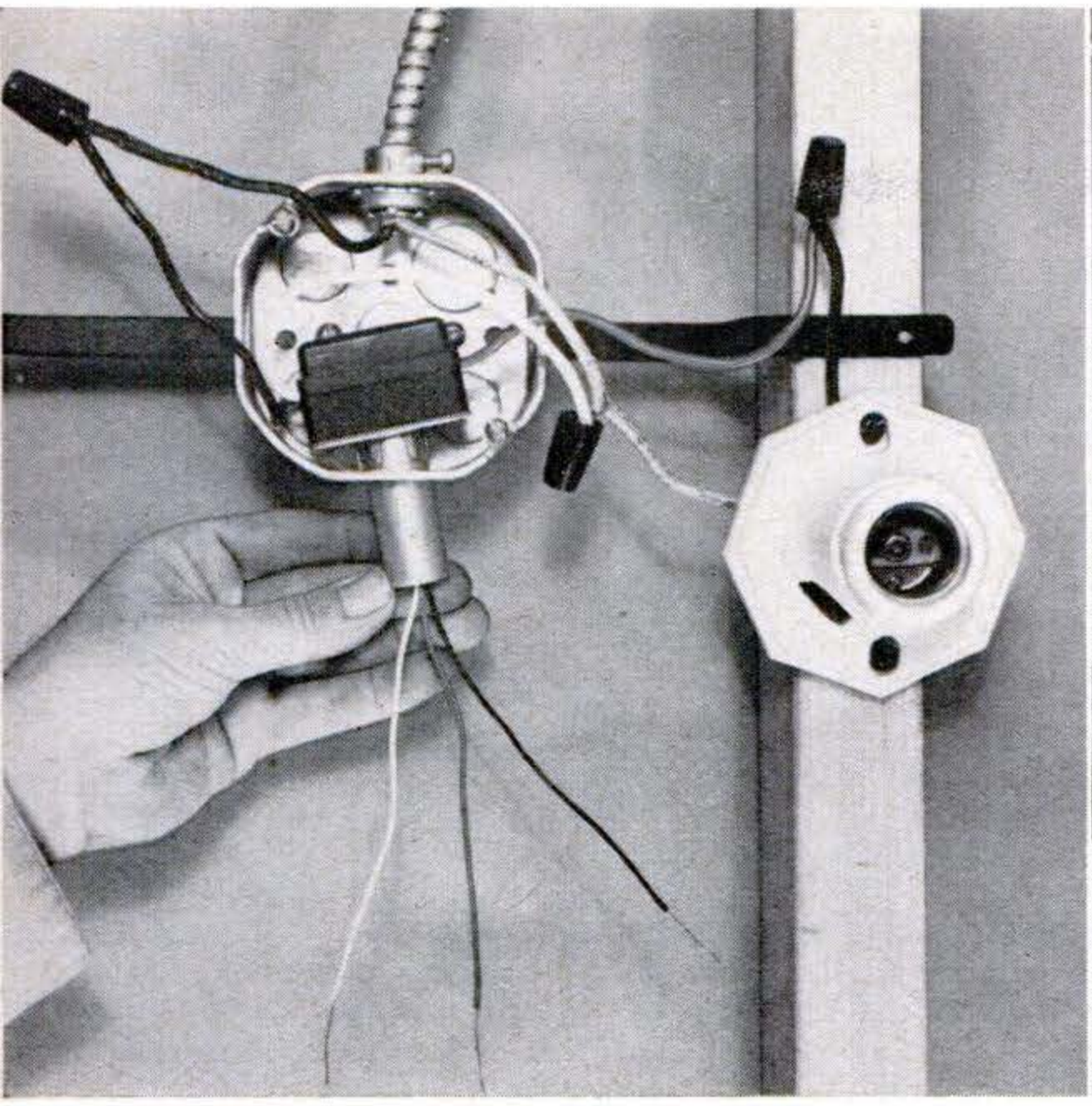
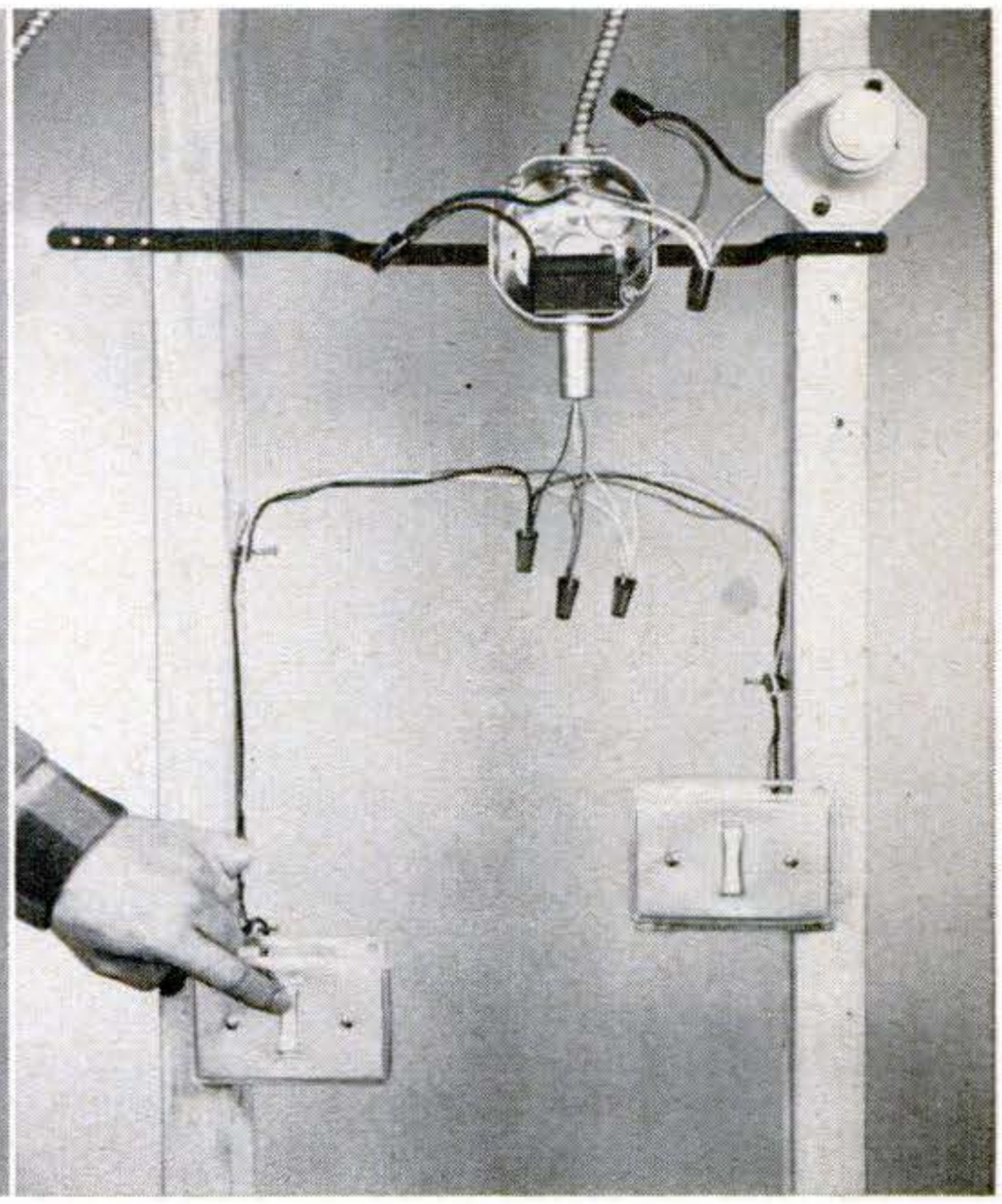


VARIATION of an outlet-mounted relay system uses a combination relay and miniature transformer for each circuit, eliminating the need for long wire connections to a common transformer. In all multiple-switching systems, wires are color-coded for easy circuitry.



MULTIPLE SWITCHING, no matter what system you use, lets you control both single- and multiple-fixture circuits from as many switch locations as you wish, as well as from a master station. It's just a matter of tying a low-voltage, three-wire line from each switch to the relay.

The only exception to this common-transformer setup (Remcon's) incorporates a miniature transformer built into the base of each relay, eliminating long, low-voltage power leads.

With both systems, the transformer provides a safety feature. Its limited output protects the wiring against overloads, even in the case of a short circuit. Thus no fuses are required. And because the switches draw current only momentarily, there is no drain on the transformer.

Relays. The relays used with either a common transformer or with the mini-transformers have pigtail wires for connections to the 115-volt circuit. At the other end of each relay is a tubular shank that fits into any ½″ knockout hole in a fixture box.

Three color-coded, low-voltage pigtails project from the shank for switch connections. Wires attached to the red pigtail go to the *ON* terminals of wall switches; those connected to the black pigtail go to *OFF* terminals. The third, or white pigtail, on relays that do not have a built-in transformer, is attached to one of the transformer leads (the other transformer lead goes to the common terminals of the wall switches). If you use mini-transformer relays, wires go directly from the white pigtail to the common switch terminals.

Wire. Plastic-coated, three-conductor wire is used in the circuitry between the switches and relays. With a common-transformer hookup, you also need two-conductor wire for the transformer leads. You can either buy this two- and three-conductor wire already made up, or twist separate, insulated wires loosely together. No conduits or raceways are required.

Wall switches. Small, two-position switches are mounted either singly or in groups on cover plates that attach to conventional gem boxes. You can also buy a rotary selector switch which you simply turn to the desired house-circuit number and actuate by pushing a single switch button. Another gem-box fitting that is particularly useful is a receptacle plate with three outlets, one of which is marked for wall-switch control (you wire the other two in the conventional way, for control at the plugged-in appliances or

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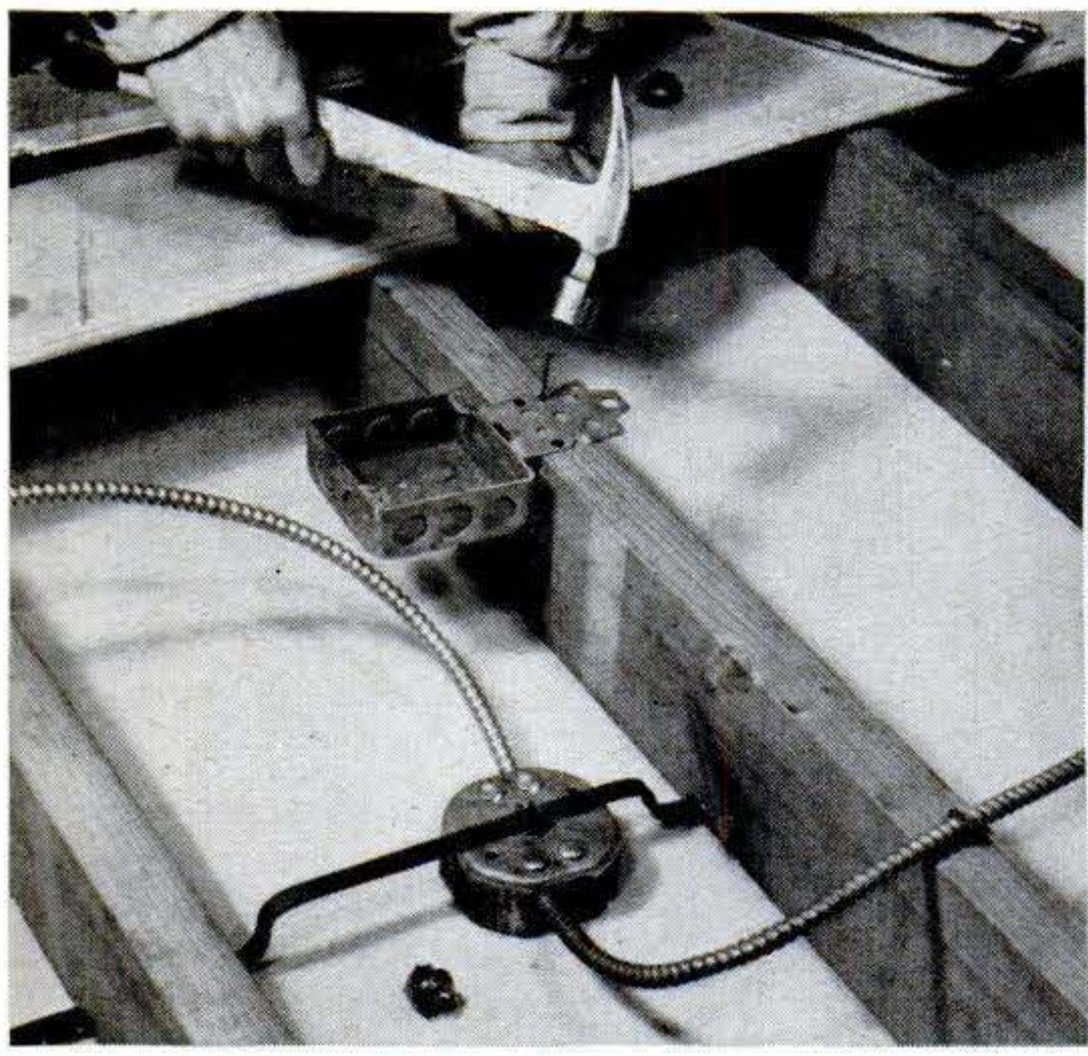
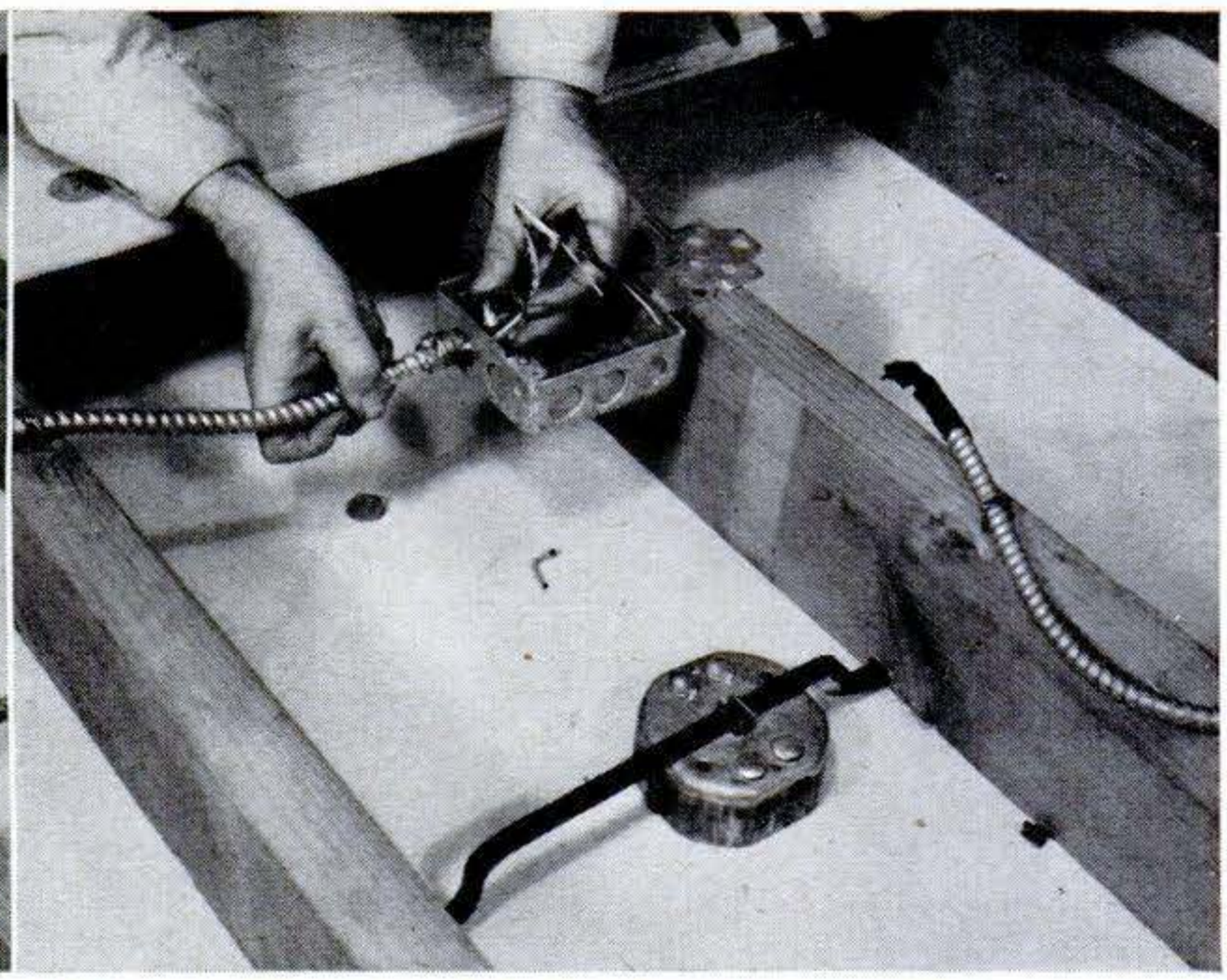
One way to solve a relay-mounting problem . . . . . .



ACCESS TO OUTLET BOXES in an unfloored attic is easy. But a center stud in this ceiling fixture box leaves no room for a relay. In such cases, nail a new fixture box with ½" knockouts to the top of a nearby ceiling joist.



DISCONNECT EXISTING POWER-FEED and switch-leg cables from the old outlet box, and run the power feed to the new one through a knockout. Tape up the end of the old switch-leg cable—you no longer have any use for it.

What the basic parts cost

PART		MANUFACTURER'S NUMBER	LIST PRICE*
Bryant and General Electric			
TRANSFORMER		RT-1	$ 8.00
RELAY		RR-2	3.30
SWITCHES	FLUSH	RFS-1	.39
	SURFACE	RSS-1	.69
	MASTER	RMS-2	6.40
WALL PLATES		RP-1, -2, -3, -4**	.27
2-CONDUCTOR WIRE		per 1,000 ft.	15.10
3-CONDUCTOR WIRE		per 1,000 ft.	21.20
Remcon			
RELAY (BUILT-IN TRANSFORMER)		R-115	$ 4.20
SWITCHES	SINGLE	S-1	.45
	MASTER	MS-9C	9.00
WALL PLATES (INCLUDING BRACKETS)		PL-1, -2, -3, -4, -5**	.40
Square D			
RELAY		1070-C	$ 3.60
SWITCHES	SINGLE	1091-C	.50
	MASTER	1109-S	6.90

*Subject to change.
**Numeral indicates number of switch openings.

lamps). All remote-control switches have color-coded terminals, to simplify the wiring for you.

Which system? Before you install any remote-control switching system, determine which fixtures are best controlled singly, and which in groups. Remember that you can also control any single fixture in a group circuit, if you install a relay at each fixture box.

Look over your house, too, with a view to special installation problems. It may be that one or another hookup, or combination of hookups, can simplify the job. If you are building a new home, running low-voltage switch circuits to remote points is not difficult, and you might go for a layout in which all relays are mounted in a single gang box, close to a common transformer.

In an old house, however, this method could present a difficult wire-threading problem. Here you might find that placing a relay in a junction box close to each 115-volt circuit is the best solution. Or the relays could be mounted in existing fixture boxes, or tied into the high-voltage switch legs in the gem boxes. The accompanying illustrations show typical examples of all such installations. Among them should be one that is just right for you.—*Ralph Treves.*

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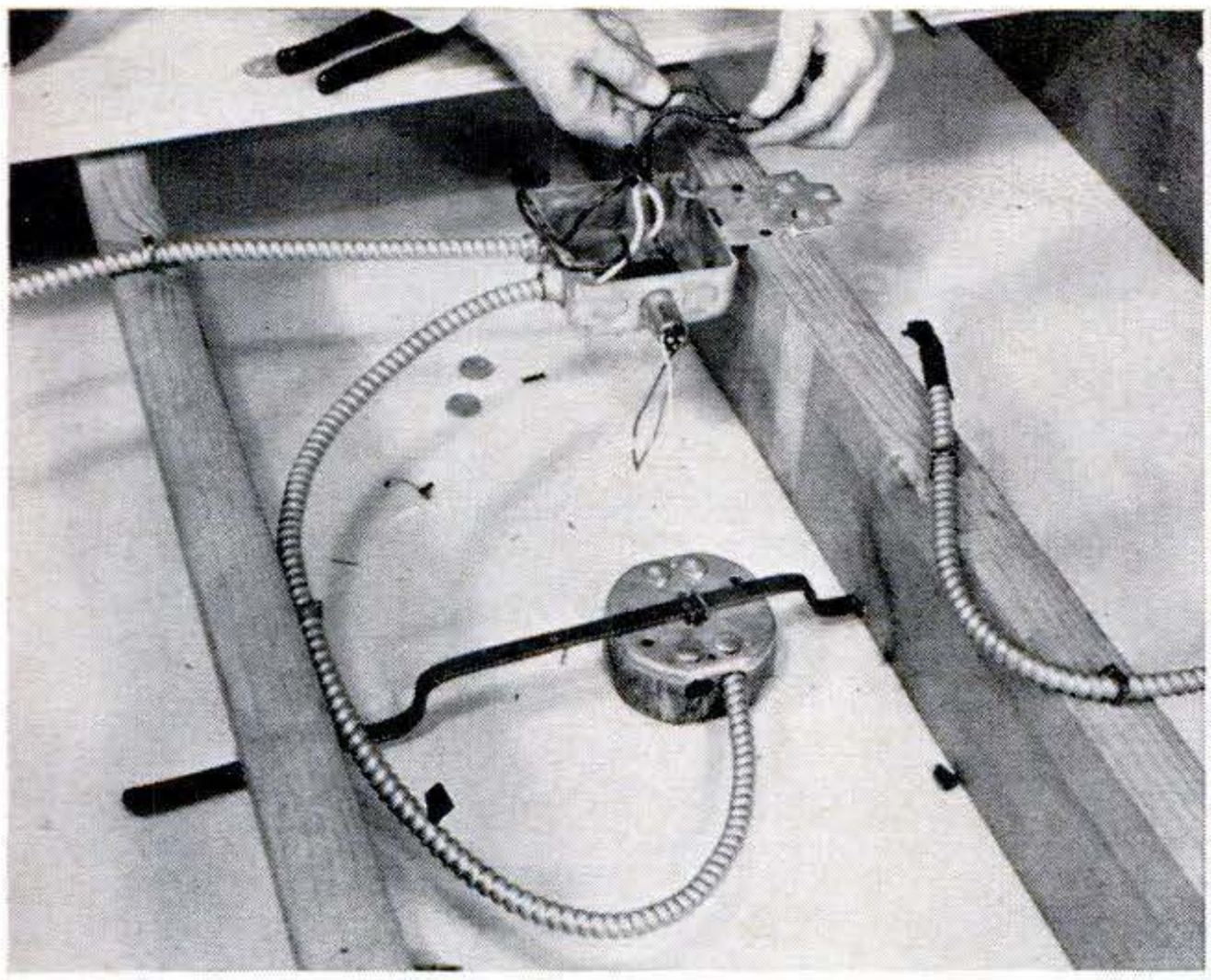
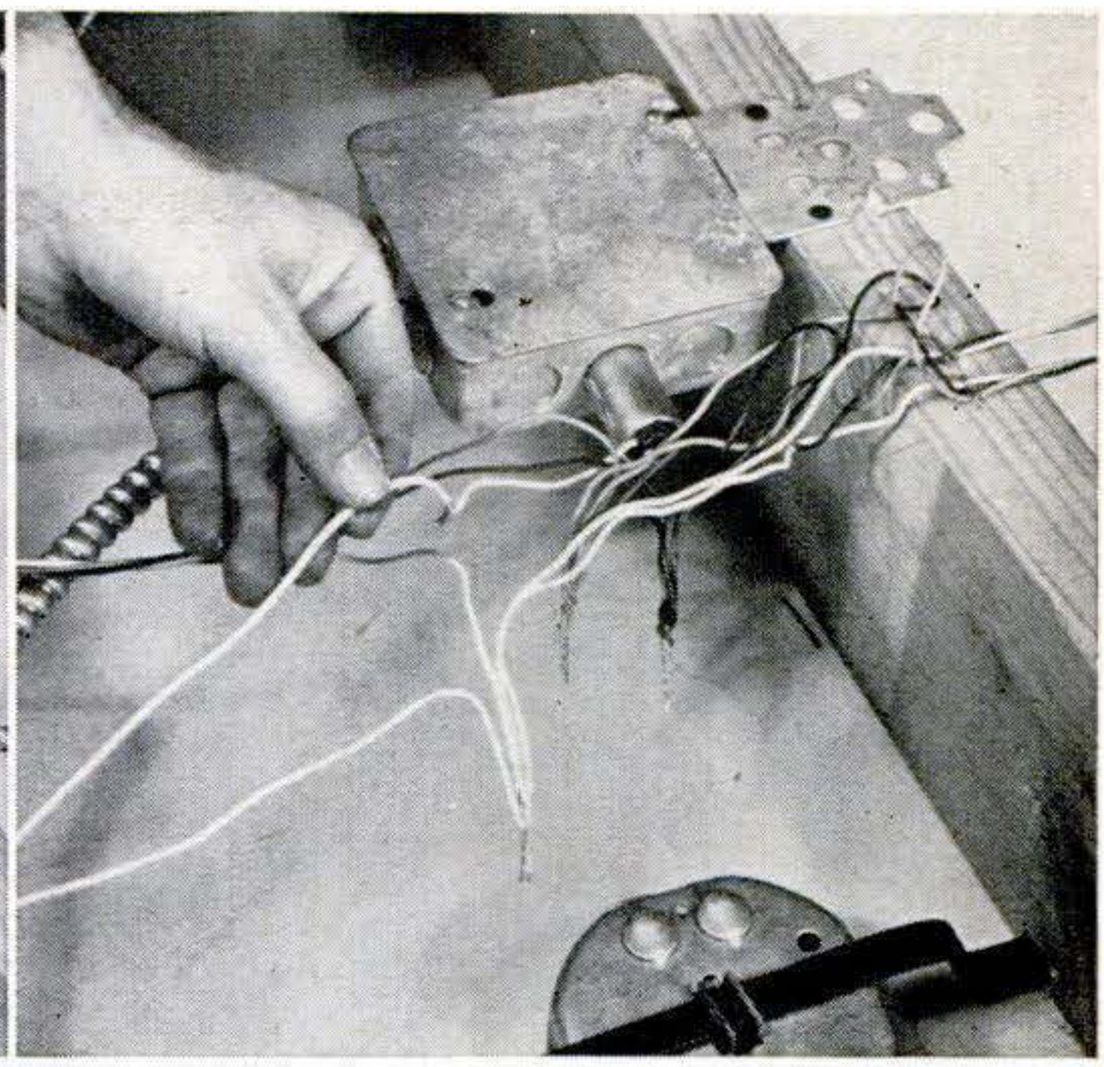
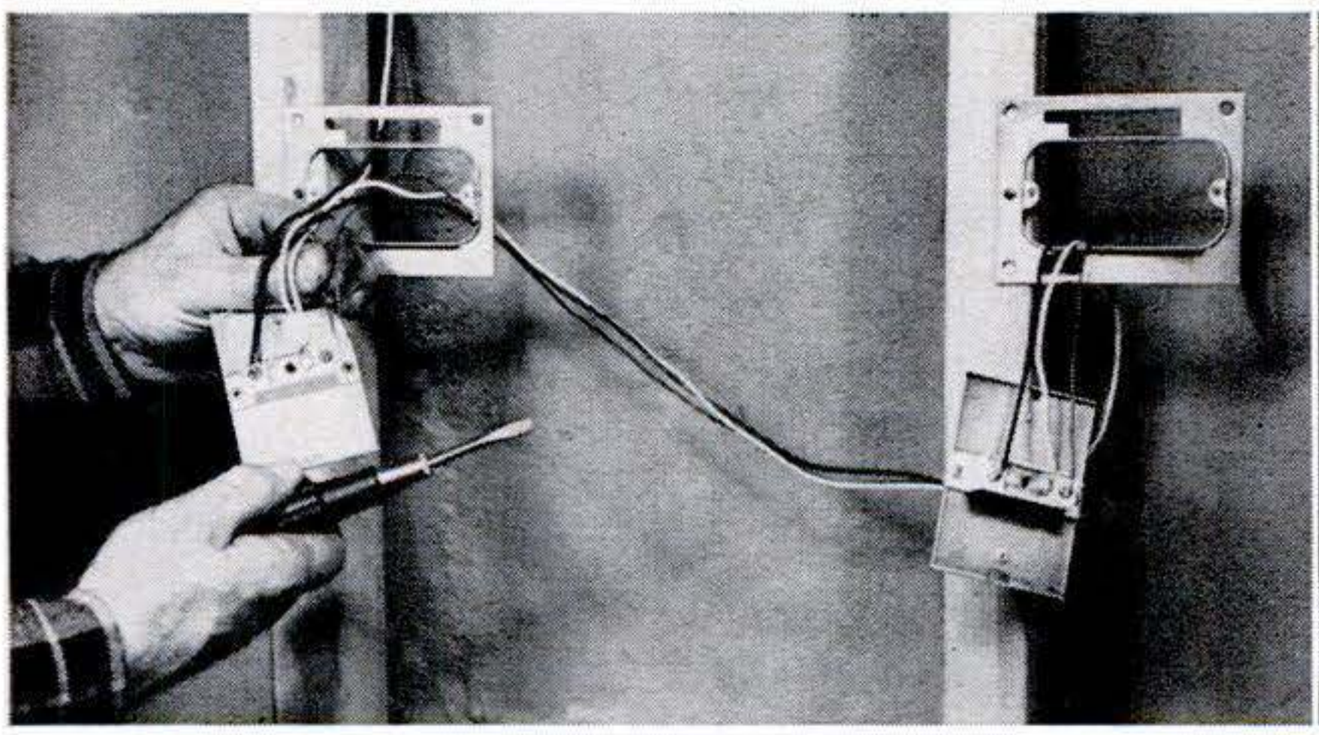


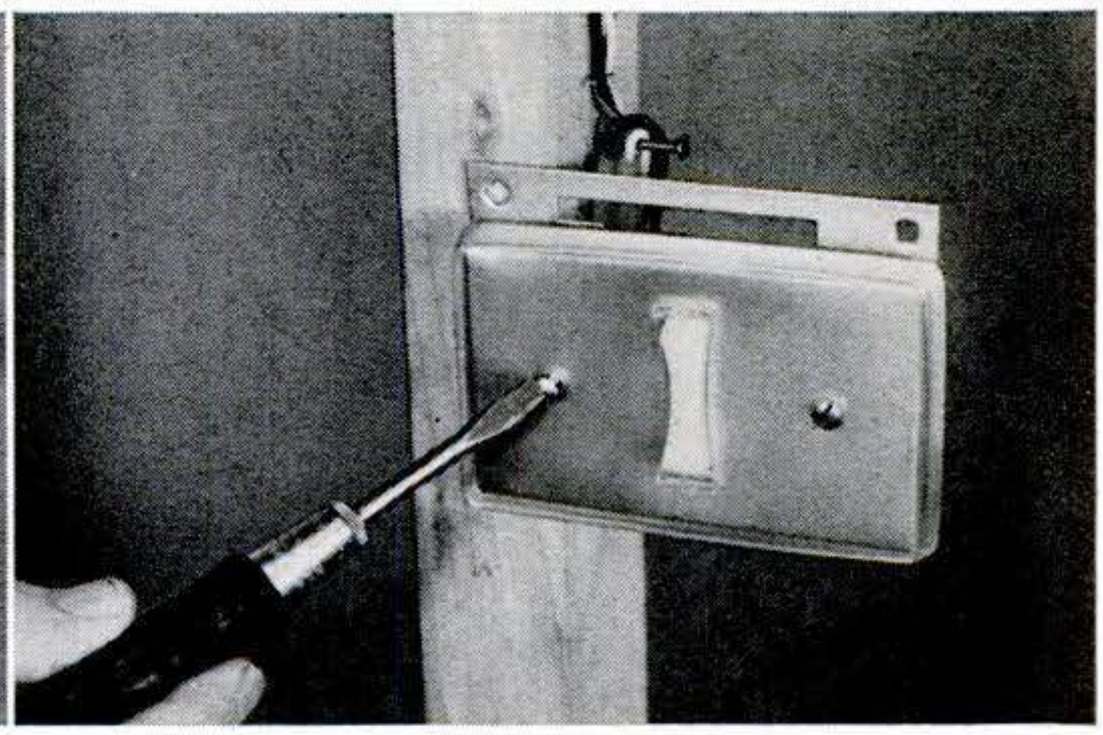
RUN A CABLE from the new box to the fixture connections in the old one. Install the relay and make soldered connections, secured with tape or wire nuts. House current will now pass to the fixture through the relay.



MATCH COLOR-CODED LOW-VOLTAGE PIGTAILS with three-wire leads going to the wall switches. Here again, use soldered connections with tape or wire nuts. You can either buy three-conductor wire, or use independent wires.

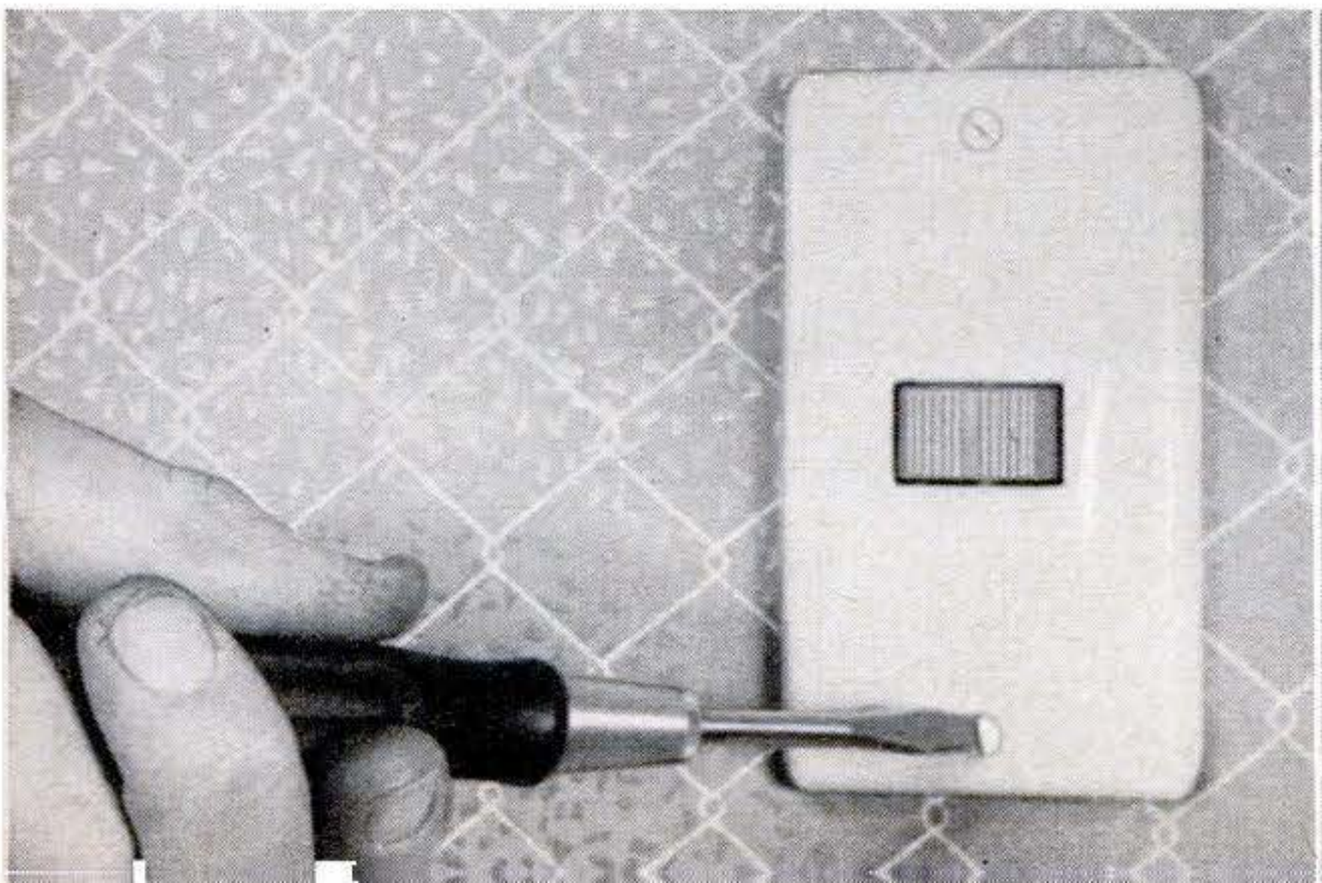
2 ways to install switches

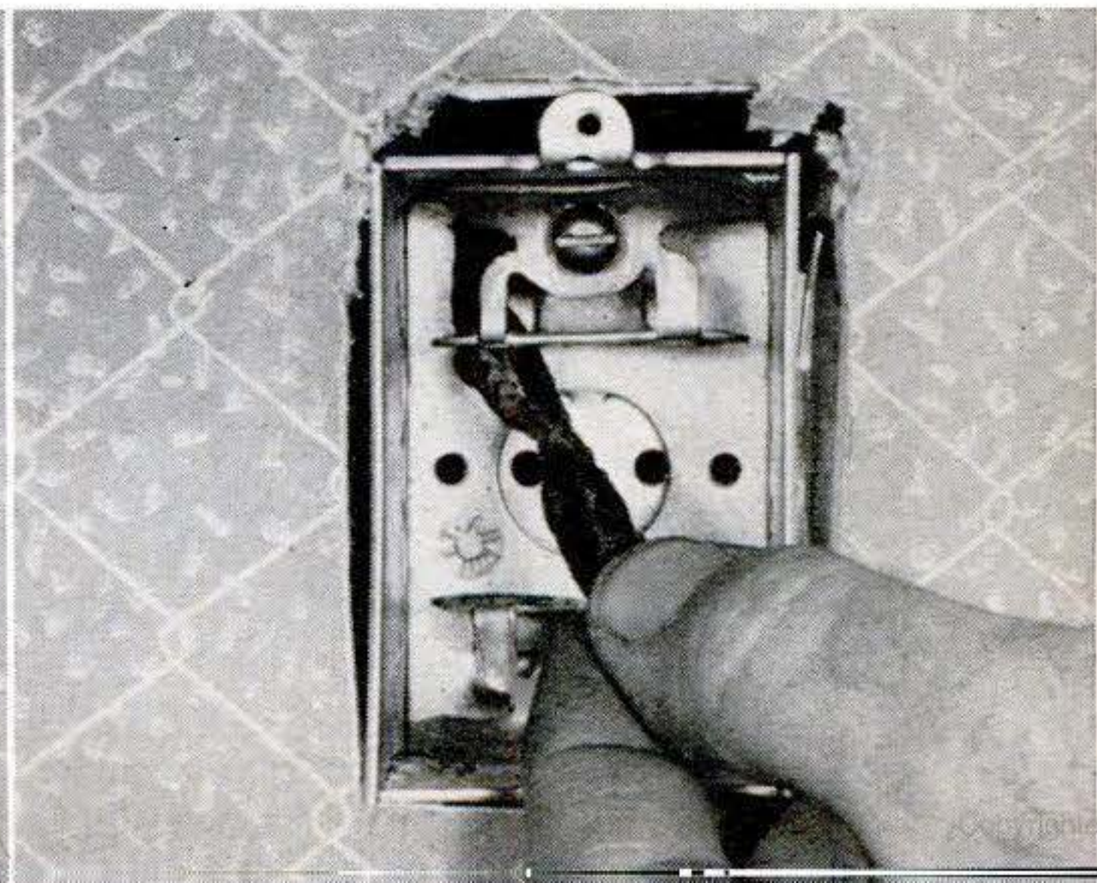




HOW TO WIRE CONTROL SWITCHES in parallel, along one lead, is shown in mock-up. Wires are continuous, with insulation stripped at each color-coded screw connection. The flush-mount switch shown consists of a plaster ring, a single switch and wall plate. Other assemblies come with as many as nine switches, or a nine-circuit rotary selector, on one plate.

DESIGNED TO FIT, some remote-control switches will go in conventional gem boxes. If the box is big enough you can also mount the relay in it, instead of in a fixture box (connect the high-voltage pigtails to ends of switch-leg wires). If you mount the relay in a fixture box, disconnect the old switch leg at both ends and push it out of the knockouts. END





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A new formula answers the big question:

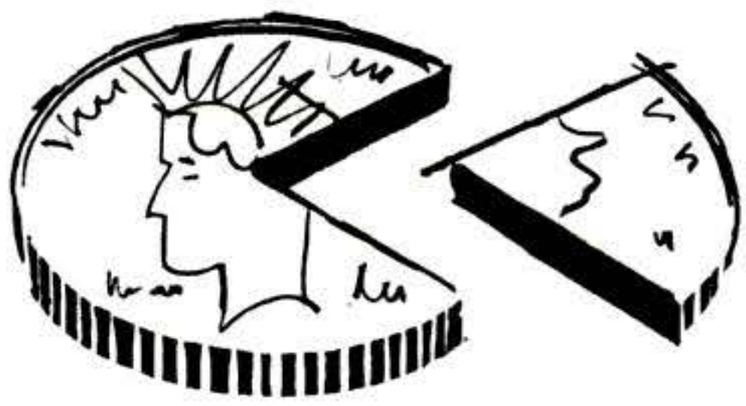
What Can You Afford to Pay for a House?

By John L. Springer

BIG changes in living standards, taxes and credit conditions in the past decade have forced bankers to figure out a new way of estimating what you can pay for a house.

The best advice used to be that you could afford one costing about twice your annual earnings. The emphasis was on the price of the house.

The new formula disregards the price



tag on the house. Instead, you're advised that you can afford housing *expenses,* figured by the month, of about one-fourth your *monthly* earnings before income taxes, social security and other deductions.

Here's an example of why a new formula was needed:

Joe and Bill each earn $6,000 a year. Each bought a $12,000 house. Joe lives in an established section on the edge of town. He pays 15 cents' bus fare to get to work. Local schools are built and paid for, so his taxes are comparatively low. He had a refrigerator, washer and dryer—all paid for—before he moved in. He pays 4½% interest on his mortgage.

Bill lives farther out, in a new suburb. He pays about $10 a month more for taxes, another $15 extra for commutation. After he took title to his house, he bought a refrigerator, washer and dryer on a two-year installment contract. Costs: another $35 a month. He pays 5½% interest on his mortgage—about $8 a month more than his friend.

Joe meets his house costs comfortably. Bill sweats it out the first of every month. Yet, according to the *old* formula, each could "afford" his house.

The up-to-date way of figuring, could have kept Bill in the clear. This method would have told him that he was about to get beyond his depth financially. Since the new approach pins down all your housing costs on a monthly basis like rent, it's made to order for today's home seekers, dedicated buyers on the installment plan.

"We make thousands of mortgages every year," says Andrew Wilson of the Dime Savings Bank of Brooklyn. "We find that most new home buyers are more concerned with what they have to pay every month than with the builder's price. They're used to paying rent and paying off installment loans by the month, and it's easiest for them to visualize housing costs the same way."

This monthly basis of figuring is now

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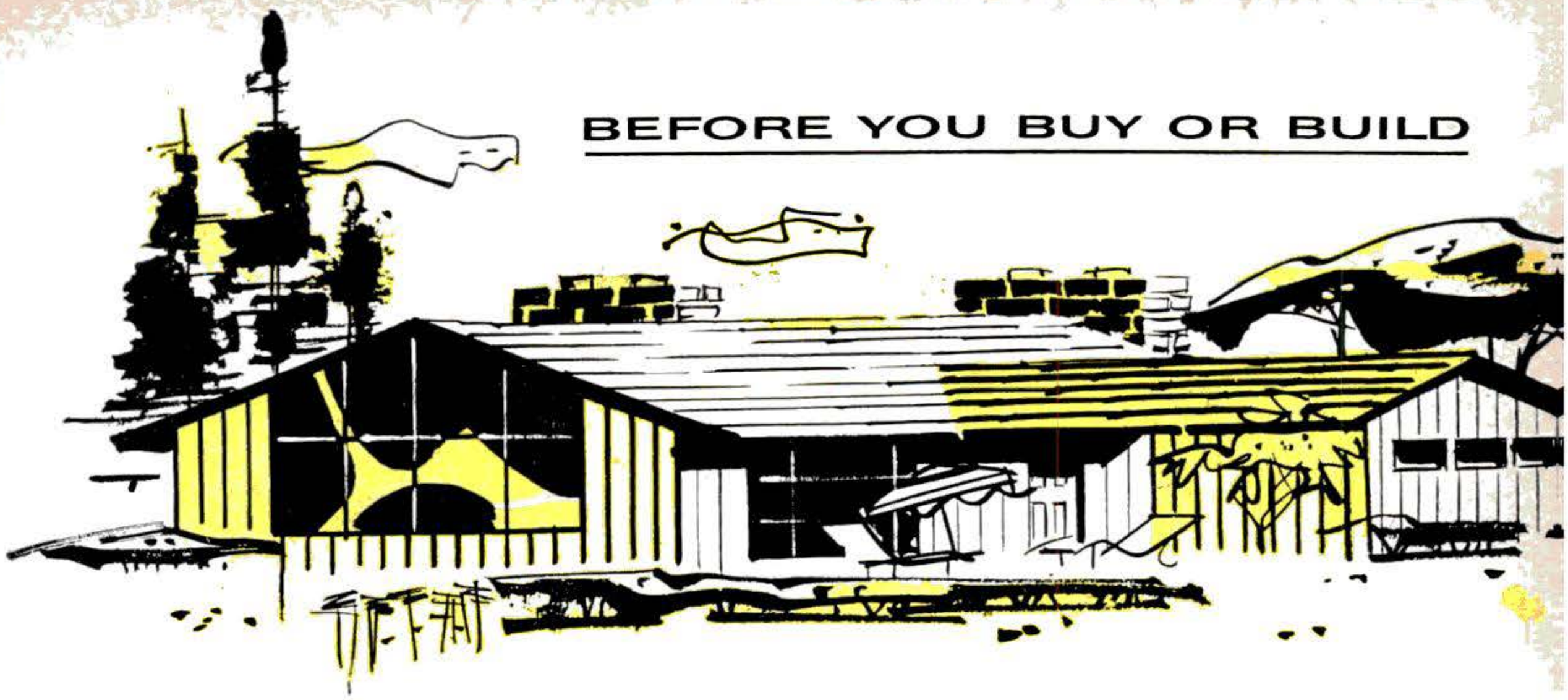

used by the Veterans Administration and Federal Housing Administration—which insure mortgages—and private lenders such as savings banks. Here's one version:

You take *all* expenses related to your house. This list includes your regular monthly outlay for taxes, interest and payment to reduce the mortgage; commutation to work (and to schools if your youngsters use public transportation); heating; sewer assessment; maintenance; water bills (if you buy your water); garbage collection (if you pay for that separately); and payments on appliances that used to be luxuries but are becoming musts in a modern home—items like dishwasher, garbage-disposal unit, exhaust fan.

Listing your expenses this way forces you to consider variables that drastically affect overall housing costs. These variables include:

- How much money you put down: Every thousand dollars you add to your down payment reduces by about $6.60 the amount you have to pay every month in interest and to amortize a 20-year mortgage at 5%. If you have a large chunk of savings, you might be able to afford a house priced thousands of dollars higher than the average man in your income range could handle. By making a larger down payment, you lower your actual monthly payments to the bank.

It is not recommended, however, that you strap yourself, leaving no cash backlog for emergencies. And don't forget

Beginning a new series:

Before You Buy or Build

Buying a house, or building a house, is a serious step for any family—often the biggest financial transaction in a man's life. Yet many take this step with less pause, less weighing of pros and cons, less checking of values, than when purchasing a car.

Yet a home, and the land upon which it stands, can't be checked out in five minutes as you might a car—or traded in every year or so for a new model. To most people it means permanency. The chances are that you will be paying for it, and living with it, for many years. The pitfalls facing a prospective home buyer are many, from a falsely attractive price to defects in materials and construction that will show up with the regularity of the mortgage payments.

With this article POPULAR SCIENCE *begins a fact-packed, authoritative series aimed to help you choose a house that will be not a headache but a home. Next month: "Buying a Development House."*

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moving-in expenses or that you may need to buy some new furniture for the new house.

• Terms of the mortgage: Some mortgage moneylenders may give you 30 years to pay, and charge only 5% interest. Other banks want 5½% and give only 20 years. The homeowner with mortgage A obviously pays less per month than the holder of mortgage B.

• Taxes: They vary widely from community to community. Buy a $15,000 house in one suburb of New York and your tax bill may run as high as $45 a month. A few miles away the monthly tax bill on a house of the same price may be only $10. As a homeowner, you'll get part of the tax back; in filing your income-tax return, you can deduct your local property tax as well as all interest payments on your mortgage. It makes a tidy sum.

That's why, here, you figure your gross income, before deductions, in computing what you can pay for a house. And other payments you make, for Social Security and pension plans, are of course really savings that you would otherwise budget for.

• Utility costs: It's strange but true, real-estate men told me, but new home buyers, used to apartment living, often forget that they must now pay for water (unless there is a well) and heat. Those items are paid for by landlords, and tenants forget that they exist.

• Time-payment plans: How you pay for your home appliances may enable you to carry a higher-priced house.

Say you have a choice of House A versus House B. The first is $15,000—but that price includes appliances such as washer, dryer, refrigerator, range—$2,000 worth of "extras." Amortization payments on a 20-year mortgage at 5% interest come to about $99 a month.

House B, without extras, is $13,000. Mortgage payments are about $85.50. After you move in, you need those appliances and buy them on the installment plan. But instead of 20 years to pay, as on a mortgage, you get two years. Moreover, you pay 9% or 10%—not 5%—on the typical installment-buying loan. Every month you must dig up about $87 for appliances alone. Add that to the $85.50 going out on the house, and for quite a while you pay $73.50 more a month than the owner of House A.

• Commutation costs: Bargain houses miles from town sometimes become mighty expensive when you add what it costs to get to work. Commutation can nick you anywhere from $6 to $60 a month. It should be figured as a housing cost.

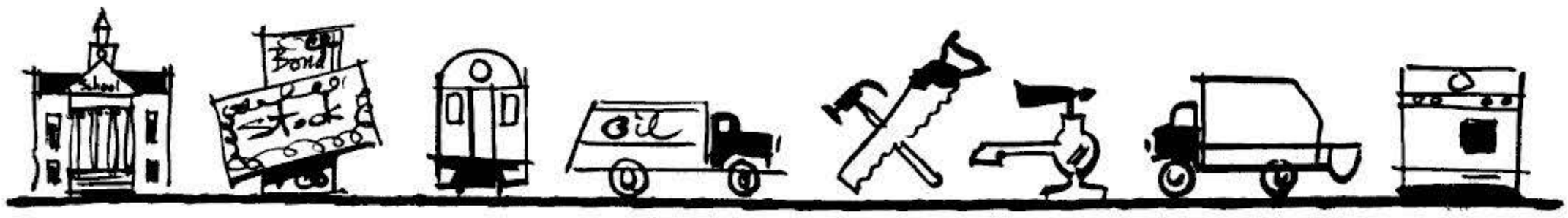
• Age of the house: A newly built home generally does not need much upkeep for the first few years. After four or five years, however, you'd better allow two percent of the price of the house annually for such items as repairs, painting, replacement of worn-out equipment.

The new formula means that if you're a $500-a-month man you can spend $125 a month on housing expenses. The average man in the $1,000-a-month class could spend $250 without feeling hurt. The cost of the house itself becomes only one factor (a most important factor, to be sure) in figuring how much you can afford.

Say you earn $600 a month, or $7,200 a year. You may find that you can't carry a house with a $12,000 price tag (well under twice your annual earnings) because other payments boost your monthly cost far above $150. On the other hand, low taxes, low commuting cost and a long-term mortgage may enable you to handle a $16,000 house with ease.

Not a rigid formula: Some authorities would argue that it's too conservative—that the average family could spend more on a house without straining the family

Figure all the bites in computing monthly housing cost



BIGGEST BITE is taken by the bank with mortgage-interest and amortization payments. Then come the smaller bites that represent the cost of day-by-day living. If all these add up to about a fourth of your monthly earnings, you are buying within your means.

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How to Figure What You Can Pay for a House

First figure your income

Monthly earnings (complete before income tax and other deductions)	_____
Value of employer's pension contributions (if any) *	_____
Value of other fringe benefits (if any) *	_____
Life insurance	_____
Health insurance	_____
_____	_____
_____	_____

*(Check with your employer about these, and their value to you)

Total Effective Monthly Income _____

Divide by four to get approximate amount available for monthly housing costs. Result: _____

Now figure your monthly housing costs

Monthly payment covering amortization and interest on mortgage	_____
All local taxes on property (per month)	_____
Fire insurance on property	_____
Commutation	_____
Average monthly heat and water bills (estimate)	_____
Sewer assessment per month (if any)	_____
Garbage collection per month (if paid separately)	_____
Monthly installment-plan payments on appliances that become part of the house (dishwasher, clothes washer, dryer, refrigerator, range, garbage-disposal unit, kitchen and attic fans)	_____
Maintenance (allow 1/12 of one percent of total sales price if house is less than 5 years old; 1/6 of one percent if it is older)	_____

Total Monthly Housing Costs _____

(Total monthly housing costs should approximate ¼ of the total effective monthly income)

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Moving-out day when a mortgage is foreclosed is something the bank wants no more than you.

budget. If the house you want comes too high, but it is important enough to you, sacrifices can be made in other ways.

A great deal, too, depends on your income bracket and your personal tastes in spending. If you're in a high bracket, you can splurge on housing and cut down on other luxuries—theaters, travel, entertaining—which others on your income level can afford. If you have a houseful of youngsters, you may spend less on shelter, more on food, clothes and school bills.

Other factors that might influence how closely you follow the formula include your own earning prospects and your town's tax outlook. If you're in a job where raises are reasonably to be expected, or have a business that is growing, you might go a little strong on housing now on the theory that earnings will catch up. But if your income is pretty well fixed—you're a civil-service employee, say —you'd better apply the formula strictly.

In some communities all basic improvements—schools, roads, town halls—are in and paid for. Taxes won't rise rapidly or unexpectedly as will those where improvements must still be made. Check on the school system. In a growing community this is the most important factor in anticipating tax rises. If your house is in a stable tax area, you might go a little beyond the one-quarter figure.

The bank's attitude: The main point in considering what you can pay for a house is to avoid having your mortgage foreclosed. You can help protect yourself by giving whoever underwrites your mortgage a true, complete picture of your financial condition.

Despite what the old nickel movies featured in their melodramas, bankers get no fun out of kicking you out and grabbing your home. Even if a banker had a heart of granite, he wouldn't want to do it. It's bad public relations, and state laws often clutter foreclosures with red tape that makes the proceedings more expensive than they're worth.

Most lending institutions don't include certain kinds of income in estimating your ability to pay. For instance, you're married, childless, and your wife works. If she's under 40, most bankers won't consider her earnings as regular income. They reason that she might have children and quit work at any time.

If you follow the formula outlined above, the law of averages says you'll be able to meet your house expenses comfortably. Surveys by the Federal Housing Administration show that the typical home buyer spends 19.5% of his total earnings for housing expenses, including utilities, maintenance and mortgage payments. When you add an allowance for commutation and home equipment, the total comes to about a quarter of monthly earnings—the formula figure. END

Add this to your Fix-It File. It'll help you maintain the tools that keep your home in order. A tool with a loose, cracked or splintered handle is a hazard. Most tools can outlast several handles; most replacements are easy.

Next Month: Window shades.

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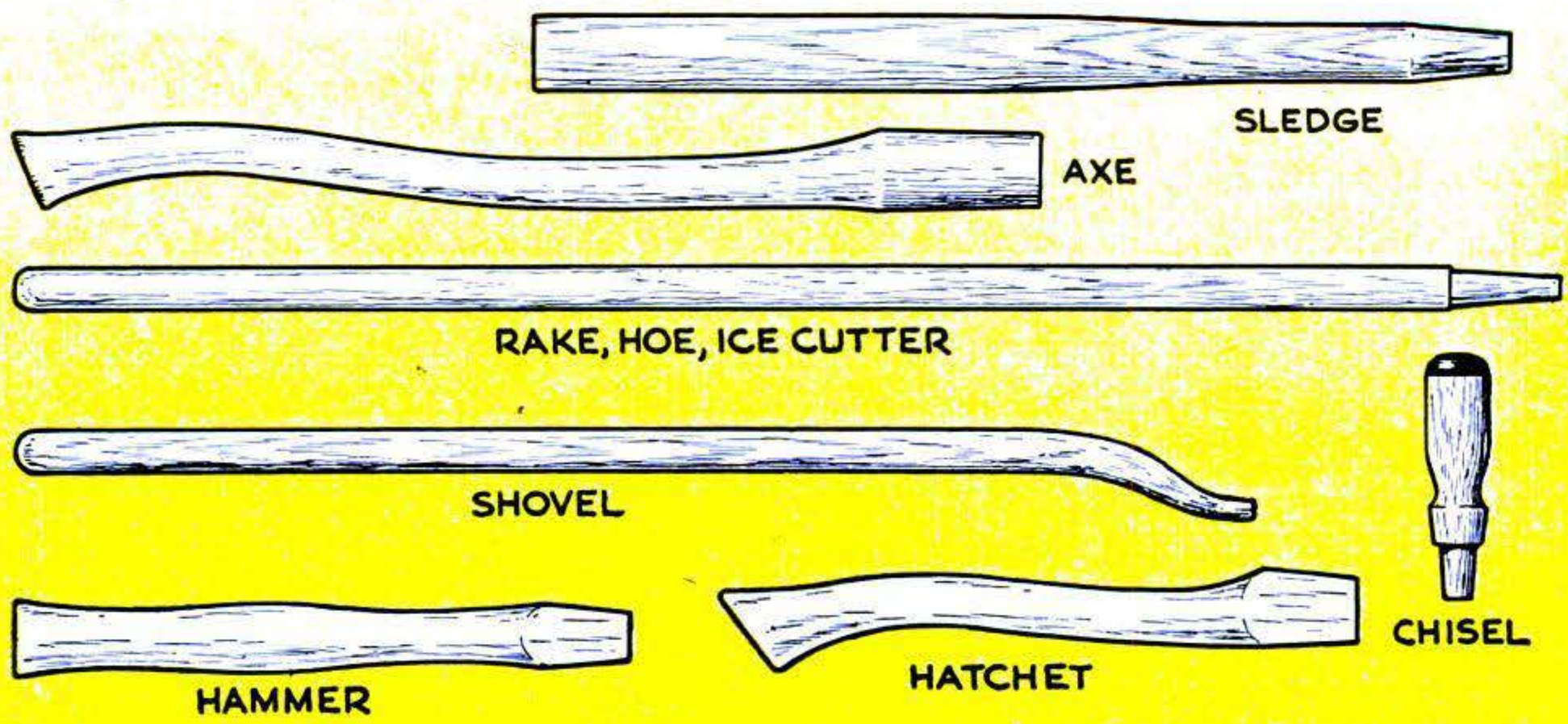
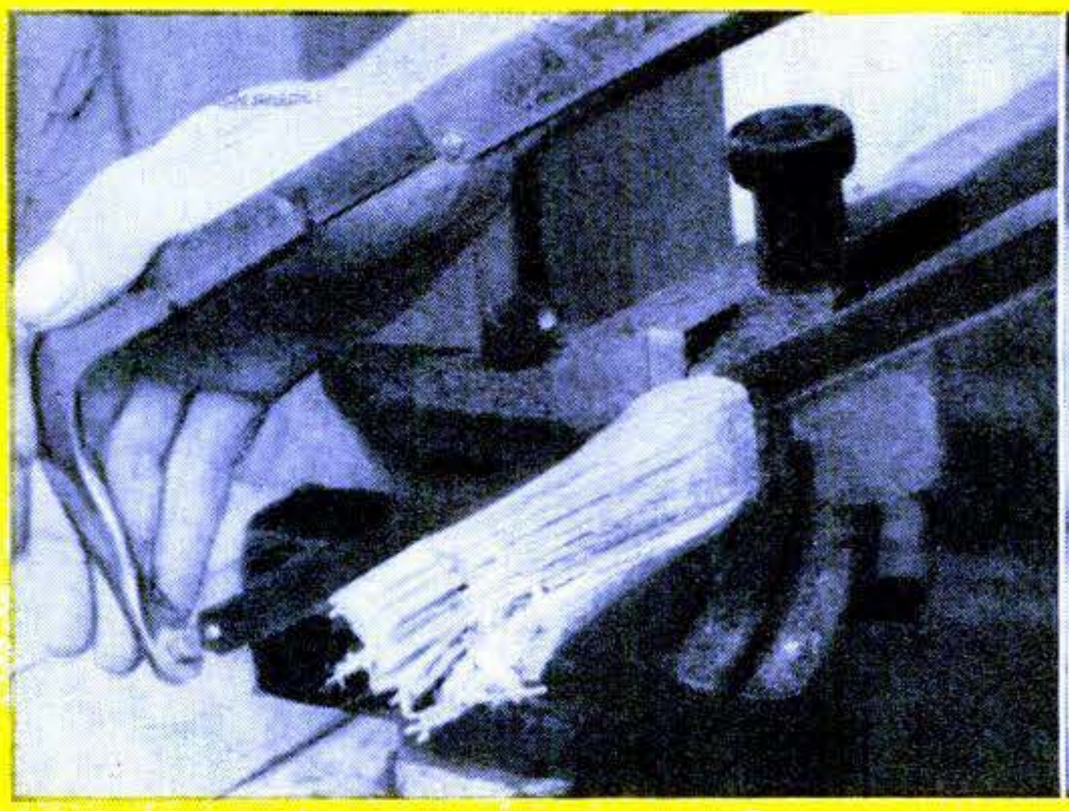
Popular Science Fix-It File

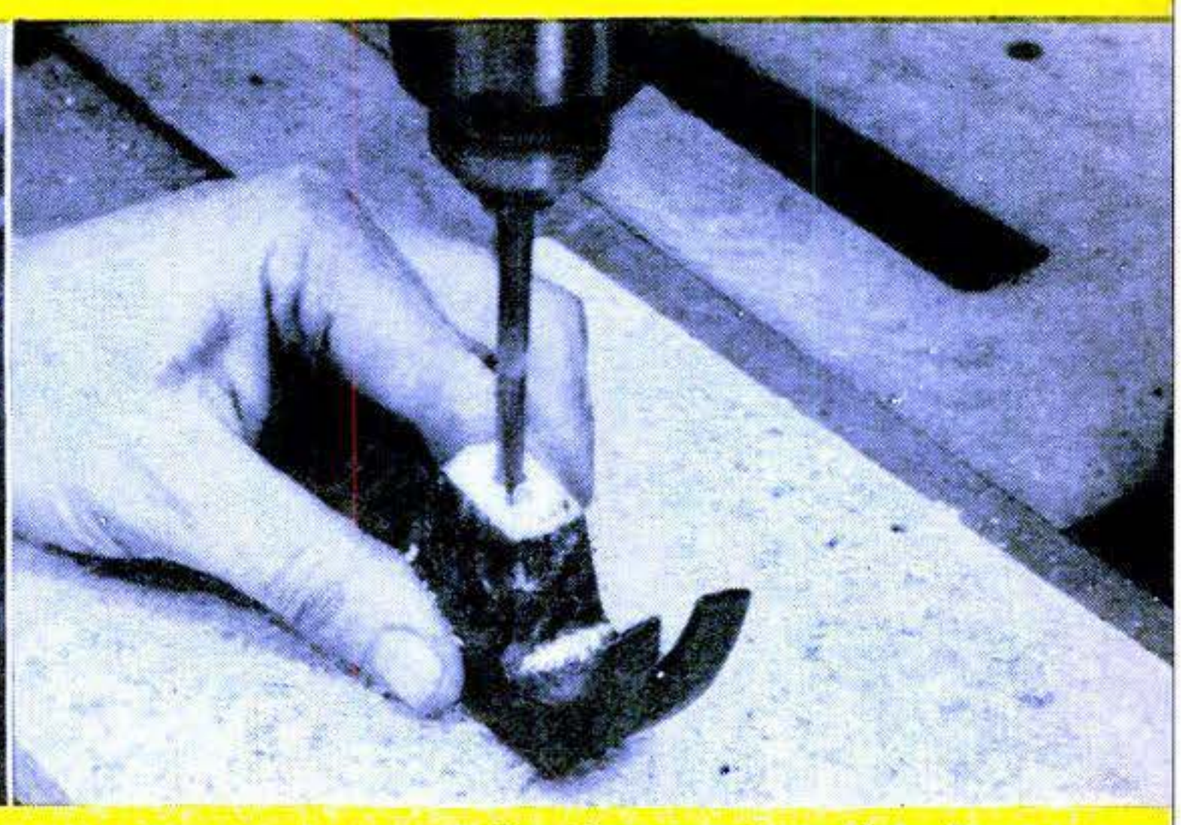


A HANDLE FOR ALMOST ANY TOOL can be bought, but take the old handle along to help you find a match, and expect to do some trimming with a plane or rasp for a snug fit.

How to fit a new hammer handle



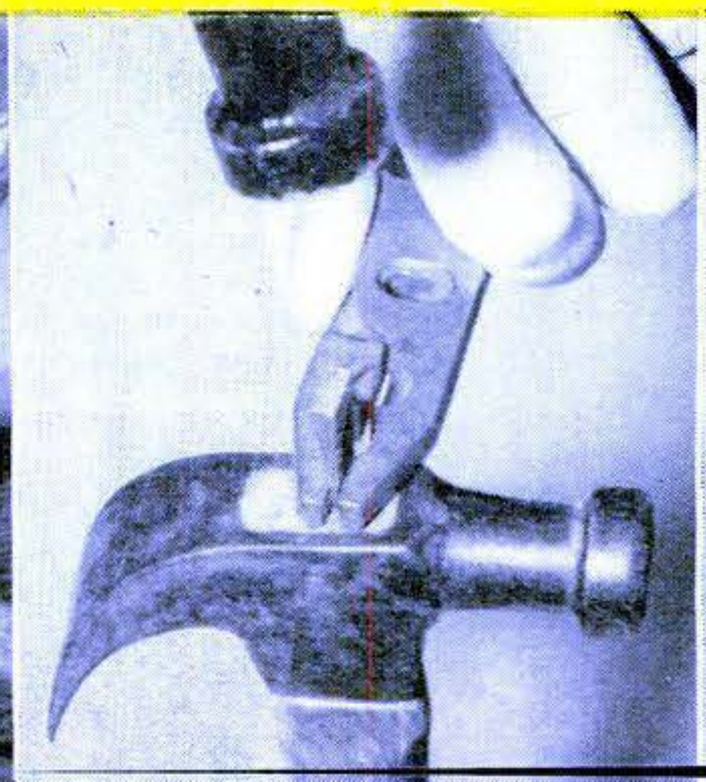
SAW OFF THE BROKEN HANDLE close to the head of the tool. Procedure is much the same for hammer, hatchet, axe or sledge. With the tool held in the vise, try to tap the end of the handle out of the eye.

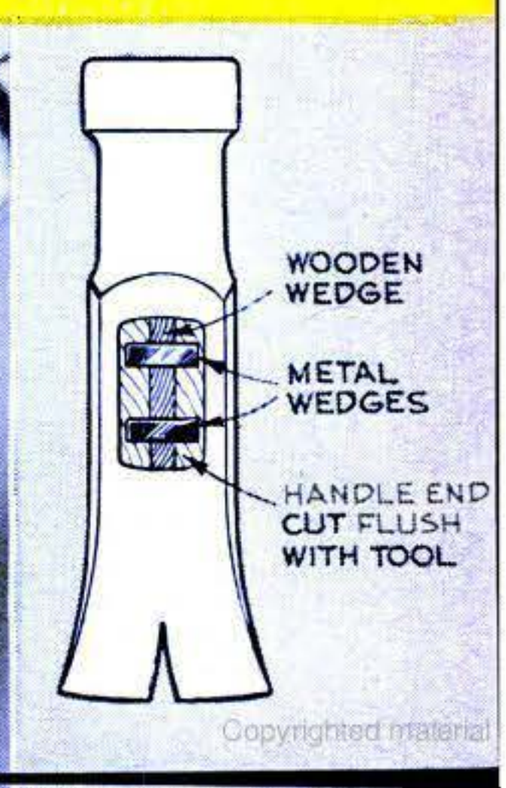


DRILL SEVERAL HOLES in the wood to break it up if you can't drive it out in one piece. (Use a metal-cutting drill in case it should bite into the metal wedges.) What's left after drilling should come out easily.

SHAPE THE END of the handle with a plane or wood rasp to make it fit the eye. Cut a vertical saw kerf about 1½" deep in the end. Drive the handle into the tool's eye until it protrudes at the other end.

USE THREE WEDGES (some dealers include them free, others charge a few cents apiece). Drive a wooden one into the saw cut to expand the handle sideways, trim flush with tool, then drive two metal wedges across it.





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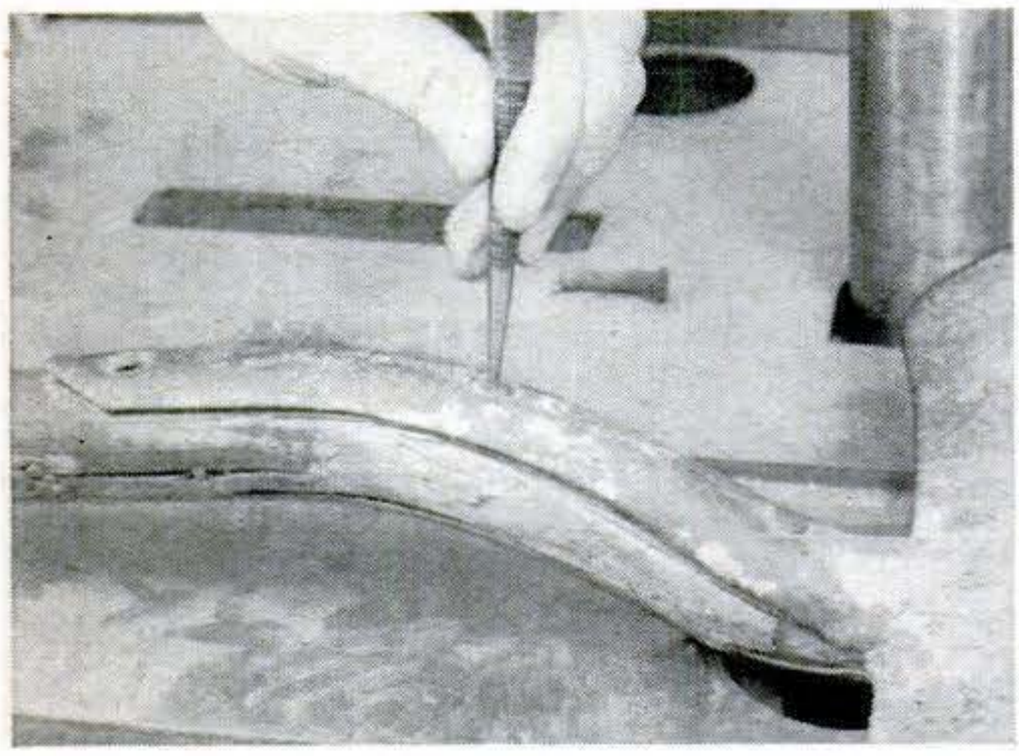
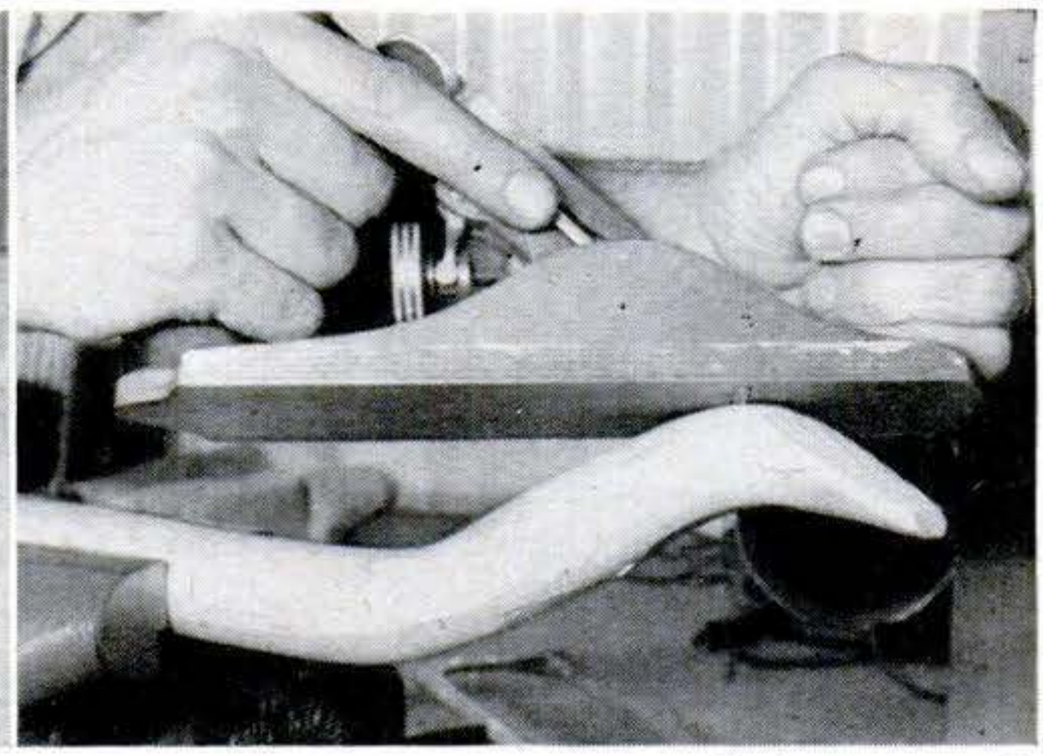
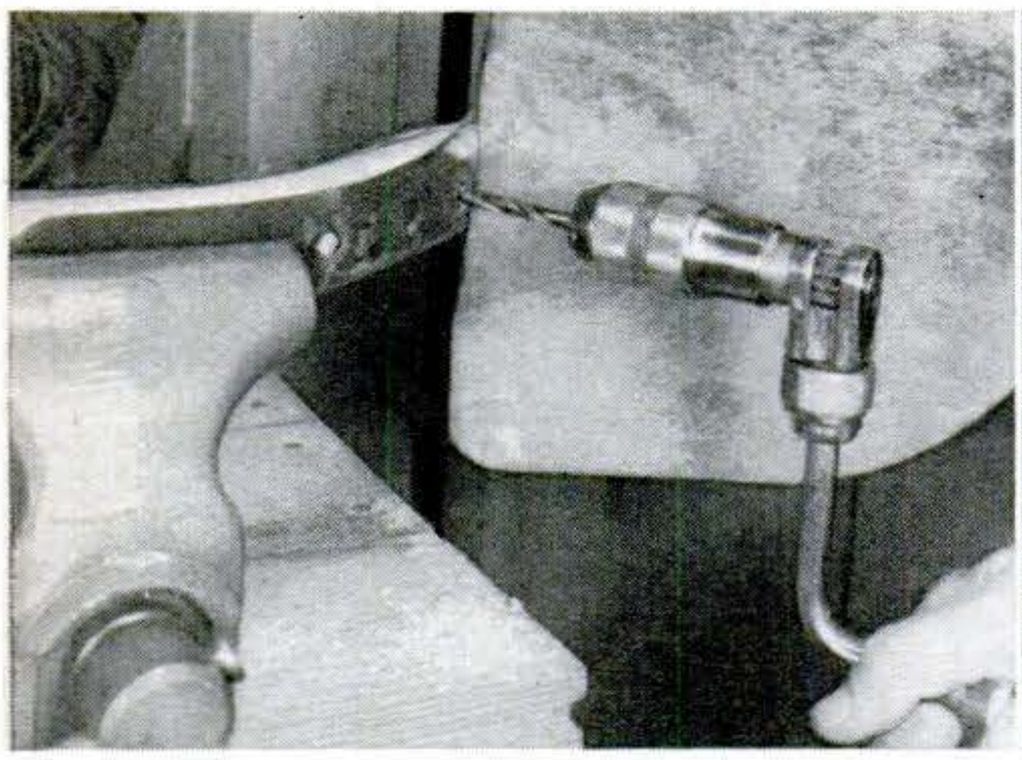
How to rehandle a shovel



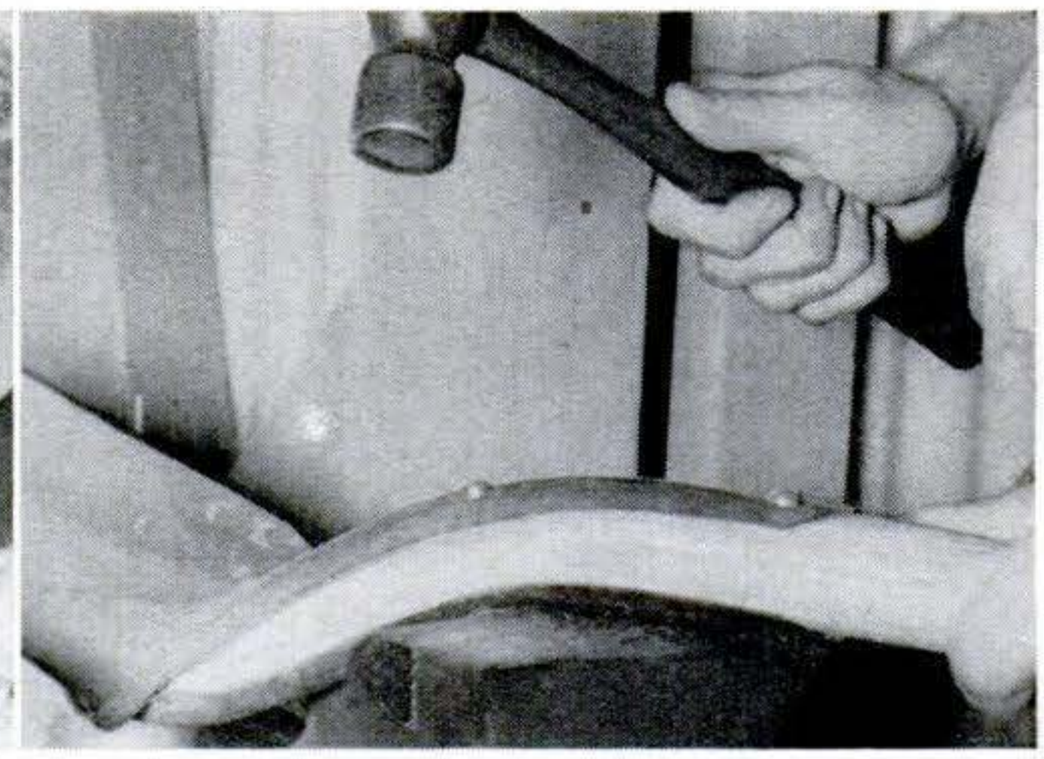
CENTERPUNCH THE RIVET HEADS, drill them off, and drive the rivets out to remove the old handle. Use a metal-cutting drill about half the diameter of the rivet head to avoid enlarging rivet holes in the ferrule.



SELECT A NEW HANDLE to match the size and shape of the old one as closely as possible (replacements also come with "D" handles). Shape the end to fit the curve of the metal ferrule. Make frequent trial fittings.

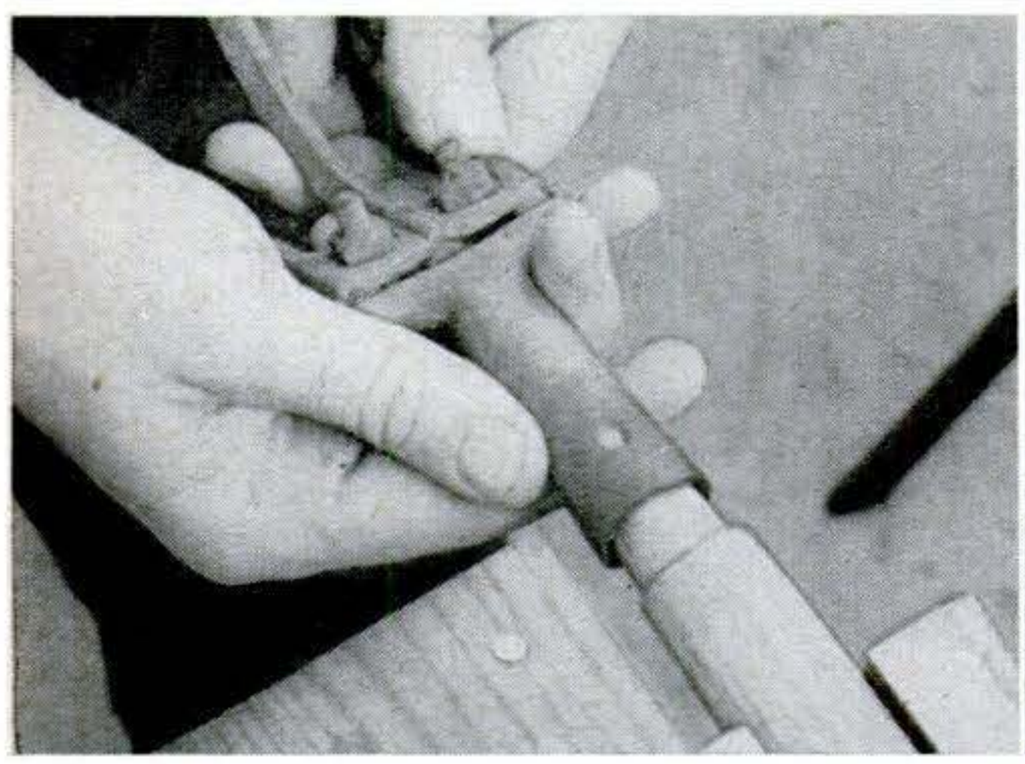


CLAMP THE FERRULE on the handle and hold parts together in a vise. Using the holes in the ferrule as guides, drill one hole through the handle and insert a rivet to hold the position. Then drill the second hole.

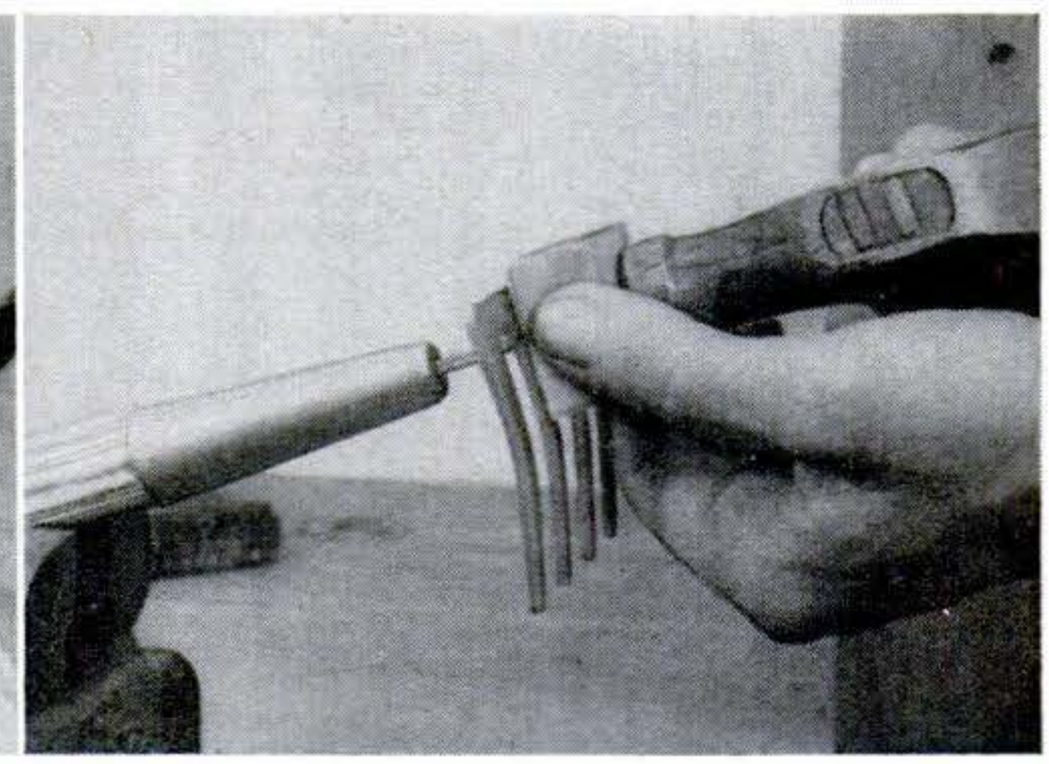


PEEN THE RIVETS OVER on the ferrule, using the vise anvil to back up the hammer blows. Hammer out any kinks in the ferrule to make edges snug against the handle. Hammer out dents or bent edges in the shovel.

How to install tapered-end handles



SOCKET FERRULES are common on long-handled garden tools and woodworking chisels. A screw will secure the handle of the garden tool above. The chisel handle, driven into the socket, is held by the taper only.



POINTED TANG, which is driven into the handle to expand the wood against a tapered shell, is found on many garden tools. Some replacement handles come with a new metal shell, but save the old one until you're sure.

Popular Science Fix-It File

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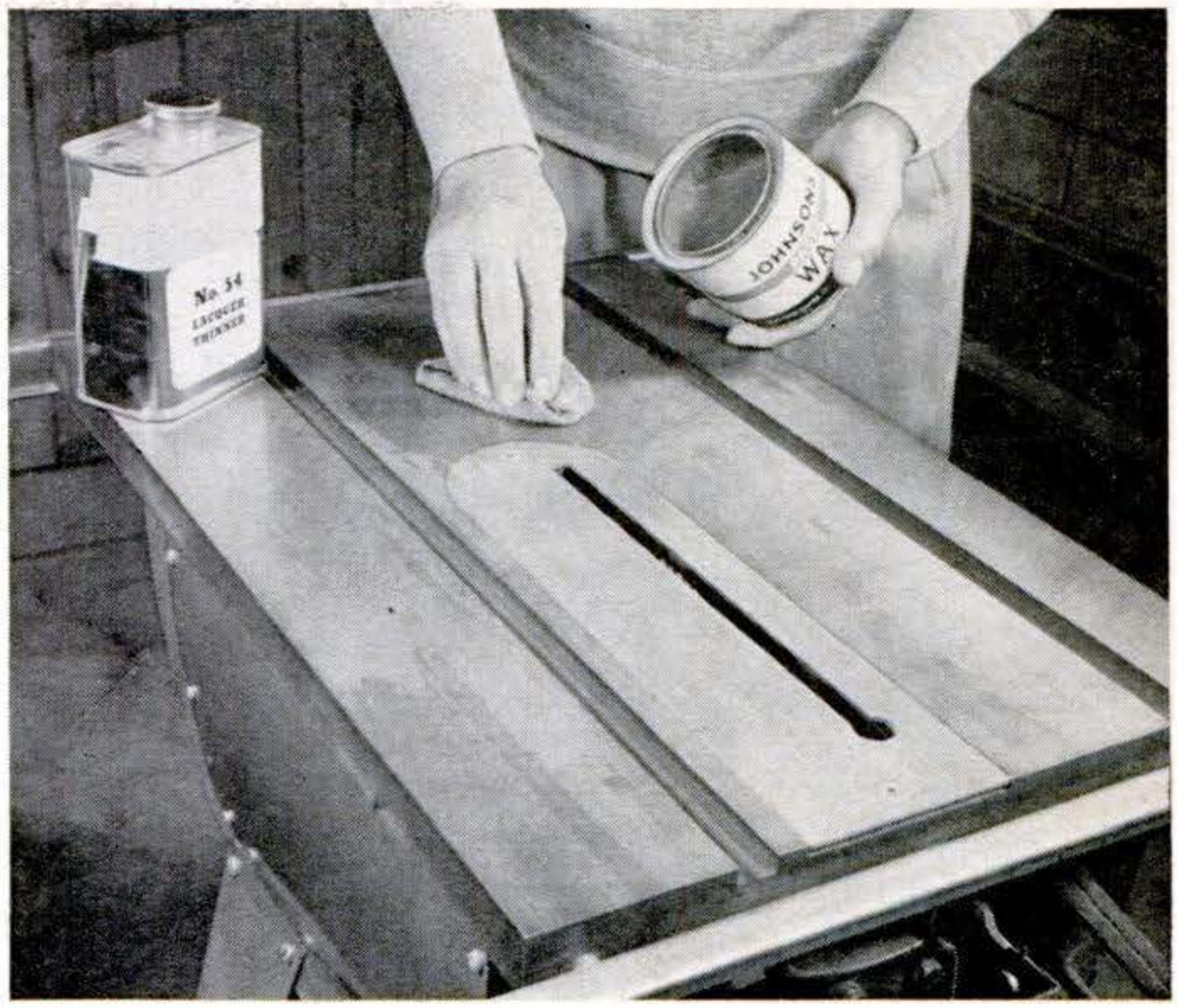
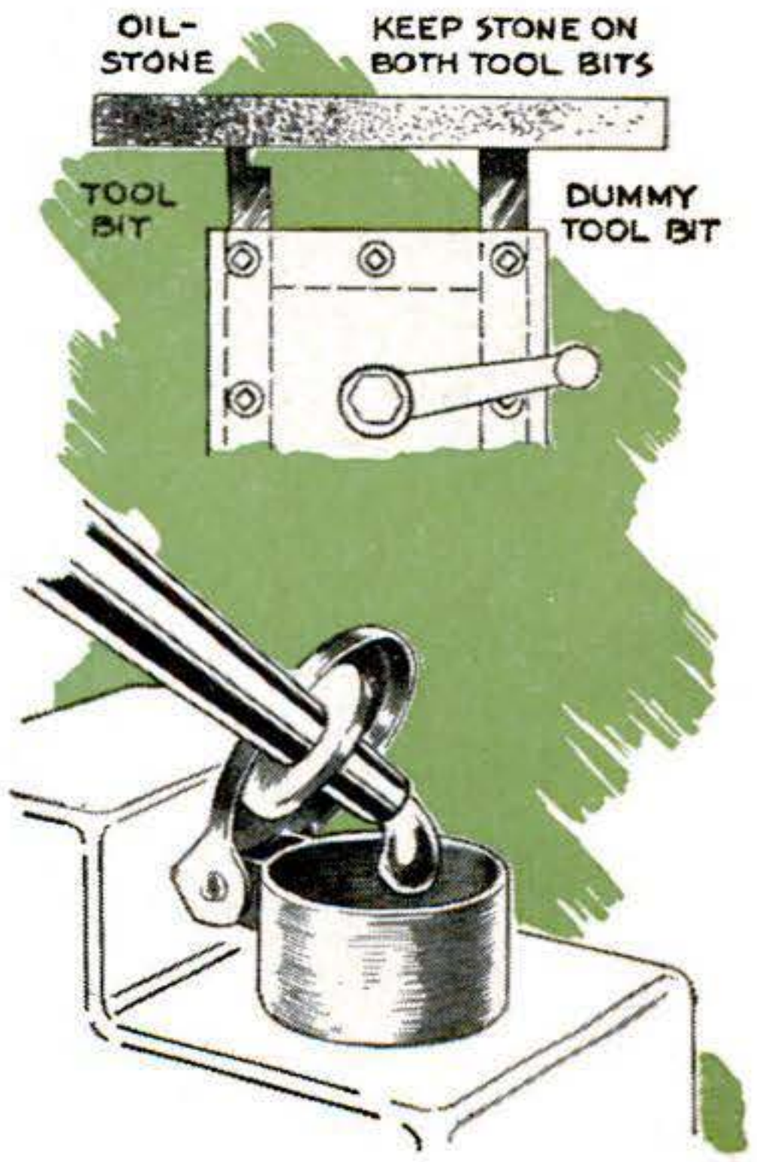
The POPULAR SCIENCE Shop Notebook



Clean power-tool tables regularly for smooth operation. Remove dirt, gum and grease with lacquer thinner, which cleans and dries quickly. Then apply paste wax to the metal surface and rub it to a high polish. This treatment will produce a sleek surface that lessens friction and decreases the pressure you must apply to move work over it, thus reducing the danger of hand slippage. The wax will also prevent corrosion and keep your tools looking bright and new.—*R. J. De Cristoforo, Los Altos Hills, Calif.*

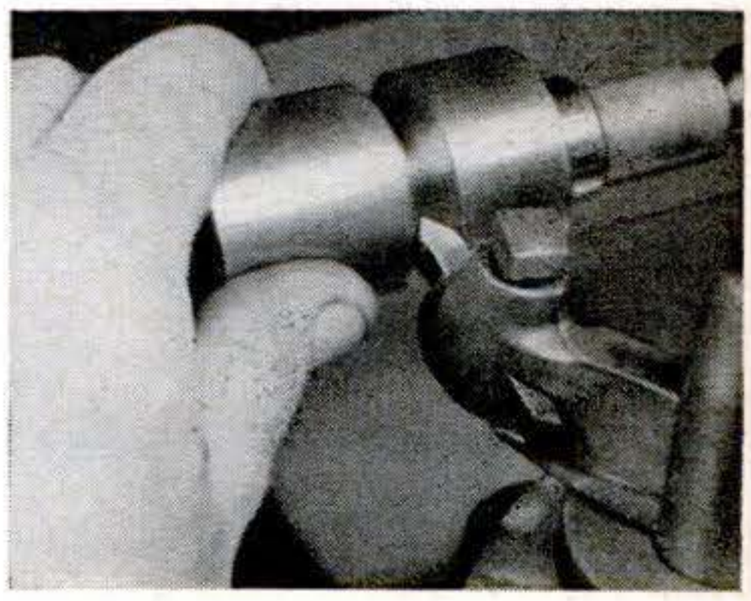
To get a straight cutting face on a narrow tool bit, place a dummy bit about 2″ away from it in the tool-post turret or bench vise and elevate it to the same plane. Lay an oilstone on both tool bits and work it back and forth across them. The long bearing surface of the two bits keeps the stone from rocking.—*Frank LaSaracina, New York City.*



To remove dried paint spots from your hands (usually discovered *after* you wash up) apply a drop of your wife's nail-polish remover and let it stand on each spot for a few minutes. The remover will soften the dried paint, and you can easily wipe it off.—*M. Robert Beasley, Jackson, Mich.*

Flip up the covers of oil cups with a small washer soldered on an oil can's spout about ¼″ from the tip. With the washer holding the cover back, you'll find the tip in the right position to deliver oil to the cup, making oiling a one-hand job.

When cutting threads in a lathe, the position of the tool bit is critical. You can get on-the-nose settings with a centering gauge made from two collars beveled 30° and mounted on a mandrel held between centers. Slip the collars on the mandrel so that the beveled edges come together to form a 60° V groove. Then adjust the cutting tool until it fits in this groove. It will fit perfectly *only* when it is square to the work and also at the proper height.—*H. J. Gerber, Stillwater, Okla.*



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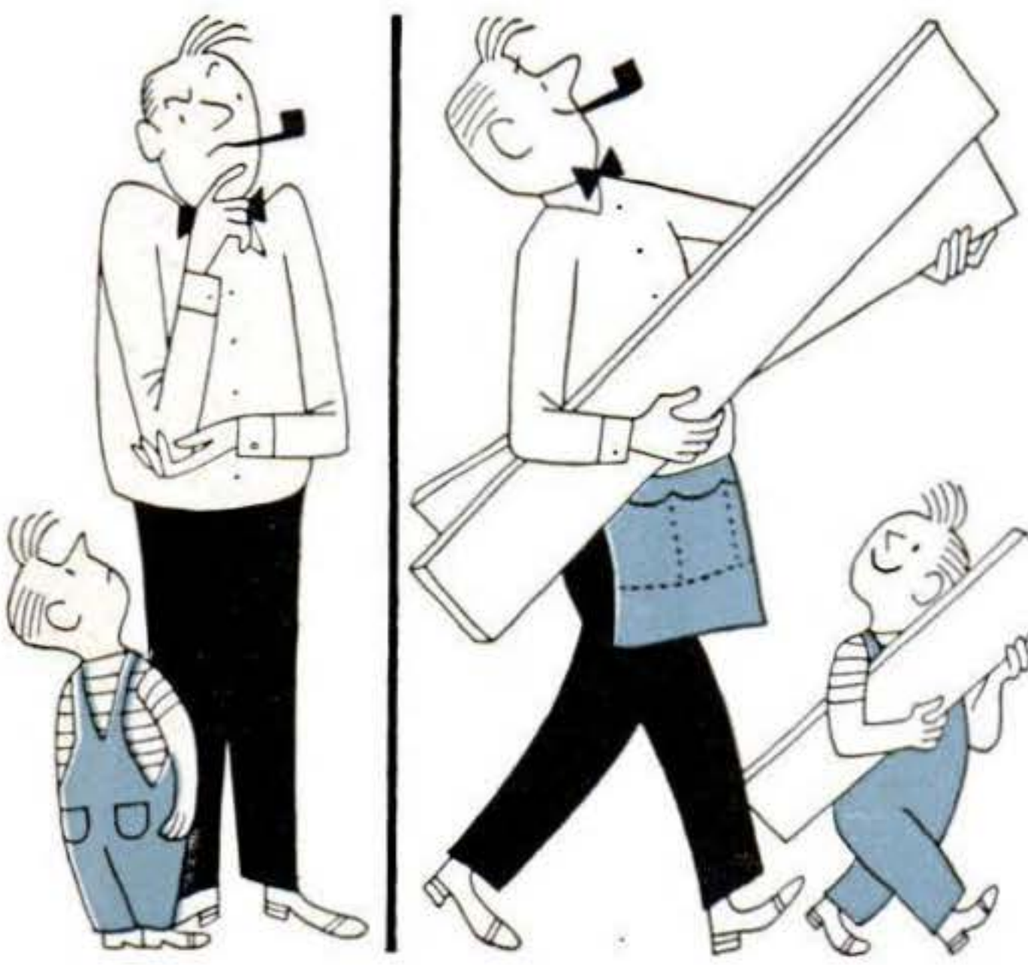
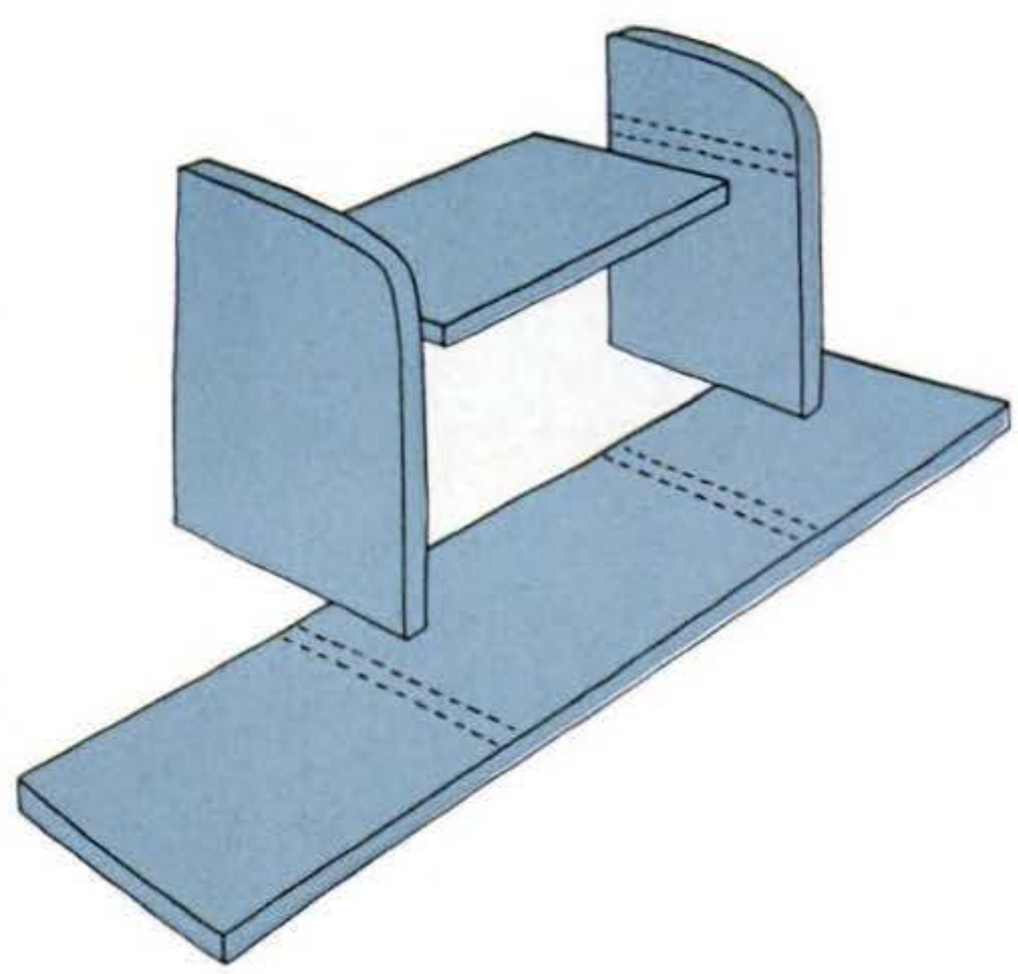
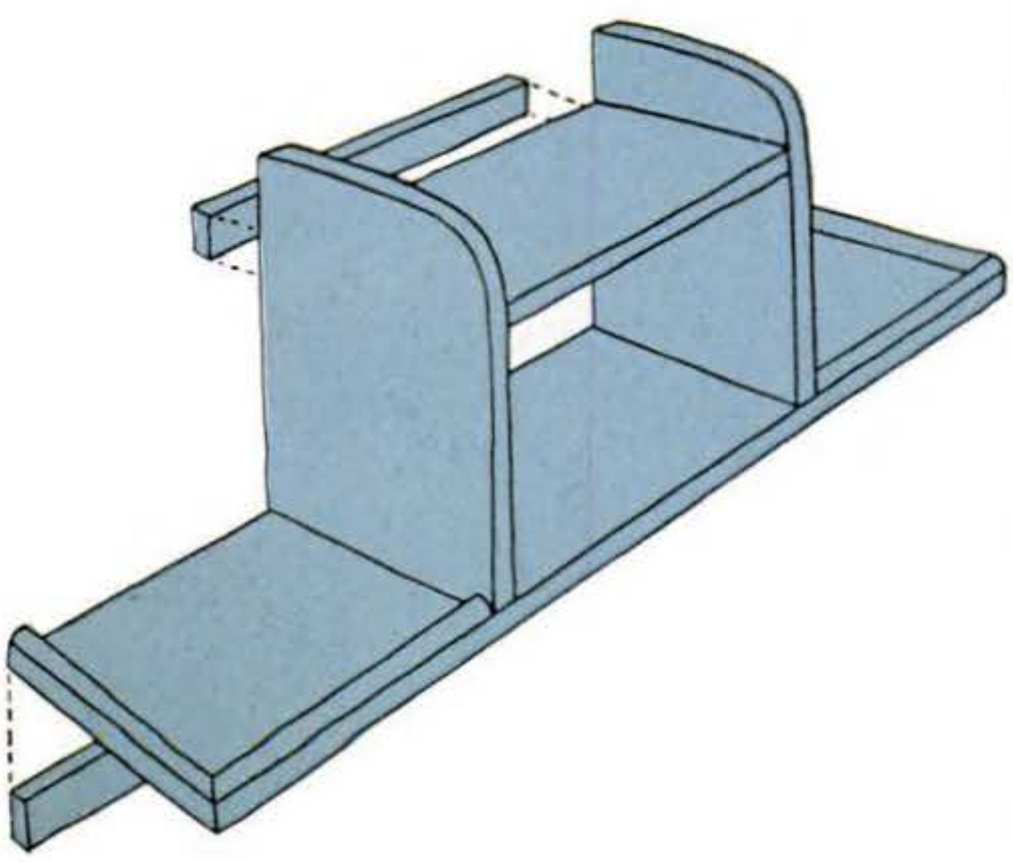
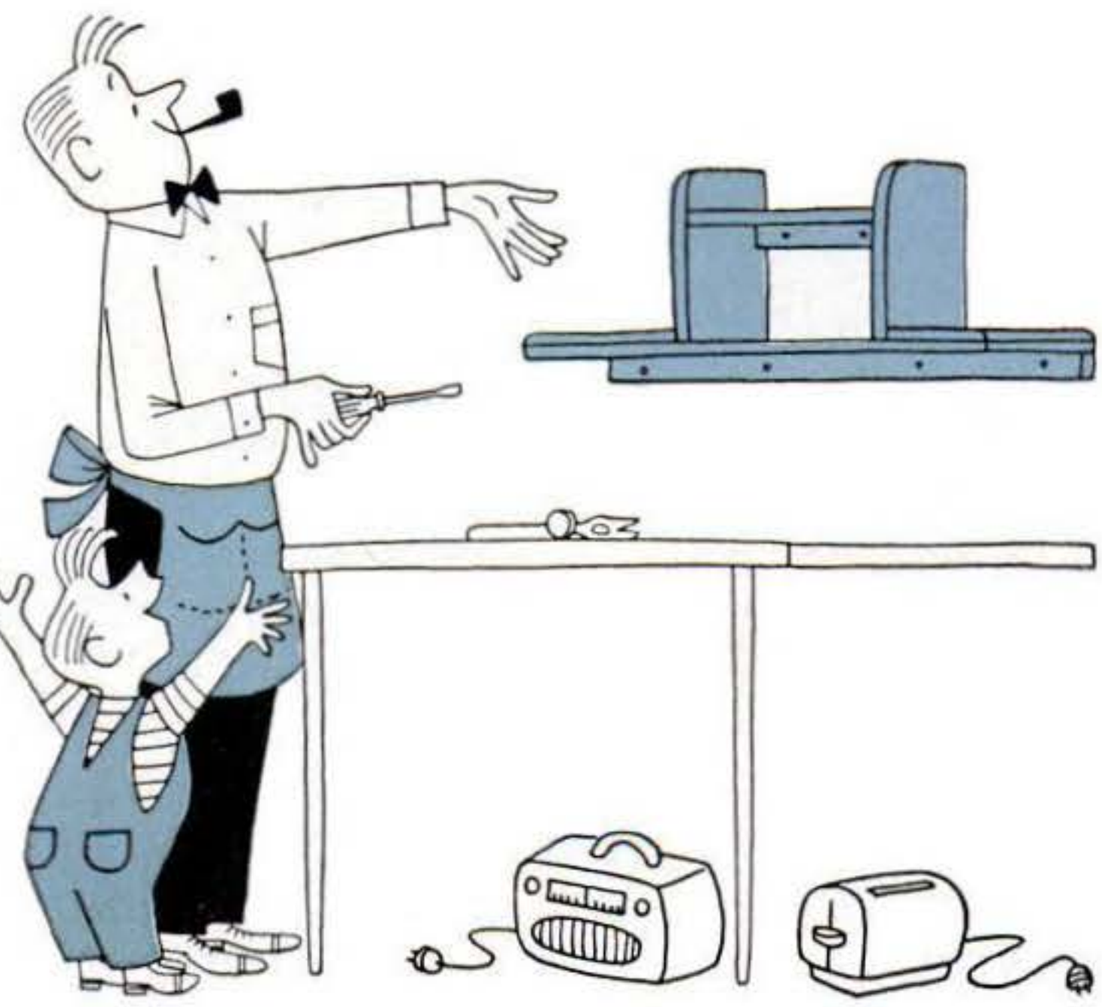
Wordless Workshop

By Roy Doty and Bebe Morrison









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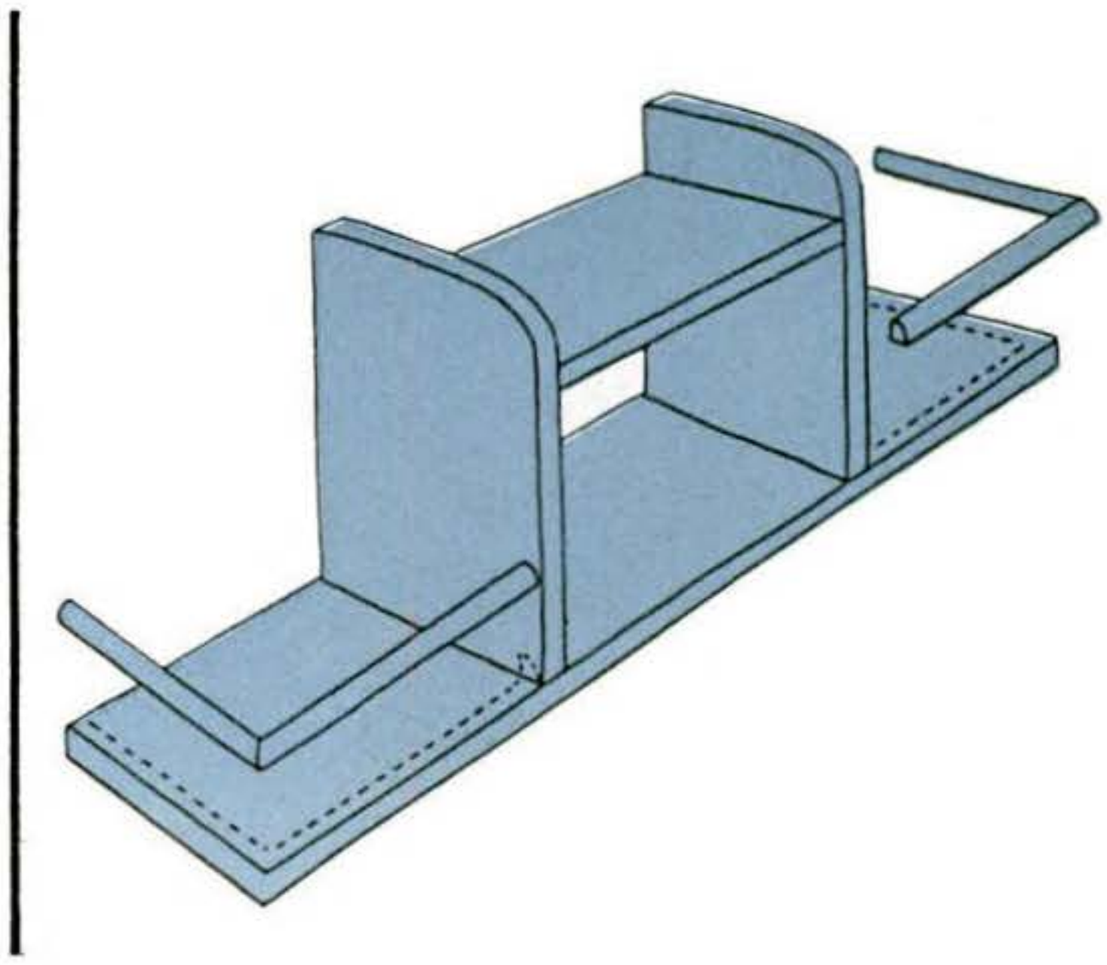

Next Month: A lighted telephone pad for easy note-taking

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Hi-Fi and Electronics

Do jiggles and pops mar picture and sound reception in your neighborhood? Here's how to get rid of them

By Jack Foster

"*ANCHORS aweigh, my boys, anchors aweigh,*" I sang lustily, if a bit off key, while running a sanding disk over a boat hull, my current weekend project.

"Stop that noise!" It was my wife shouting from the back porch. "Do you hear me, Jack?"

"Yes, my dear. Is it all right if I just hum?"

"You can yodel your head off," Madge said, venturing through a drizzle to the garage where I was working. A smile took the sting out of her words. "Your motor's causing the trouble, not you. It's coming in fine on TV. Mother and I prefer something more entertaining."

"Not TV interference again?" I protested, snapping off the rotary sander. "That's why I moved the shop out here. What do you want me to do, go underground?"

"No, dear, but you might try hand-sanding . . ."

"What?"

"Never mind, just be sure you don't use the portable saw, either. That comes in on every TV set in the neighborhood."

Madge is given to exaggeration. It's just that when Mrs. Perkins across the street squawks, it sounds like the whole neighborhood.

"Maybe you could find some nice, quiet gluing to do," she suggested sweetly and ran back into the house.

Since I had promised Madge that my power tools would not interfere with TV, I had no real comeback. I decided to take

***What the circuits on the blackboard mean**

Circuit No. 1 shows a filter for such low-power devices as shavers and doorbells. The size of choke limits the power that can be handled. RF chokes of various current ratings are sold by radio-parts stores. Use 400-volt paper or mica condensers for all filters. Circuit No. 2 is the preferred filter for low-power equipment requiring installation across contact points within the appliance. No. 3 is for fluorescent lamps up to 60 watts. Filter should be installed in the lamp housing near the ballast. Don't use large-capacity condensers.

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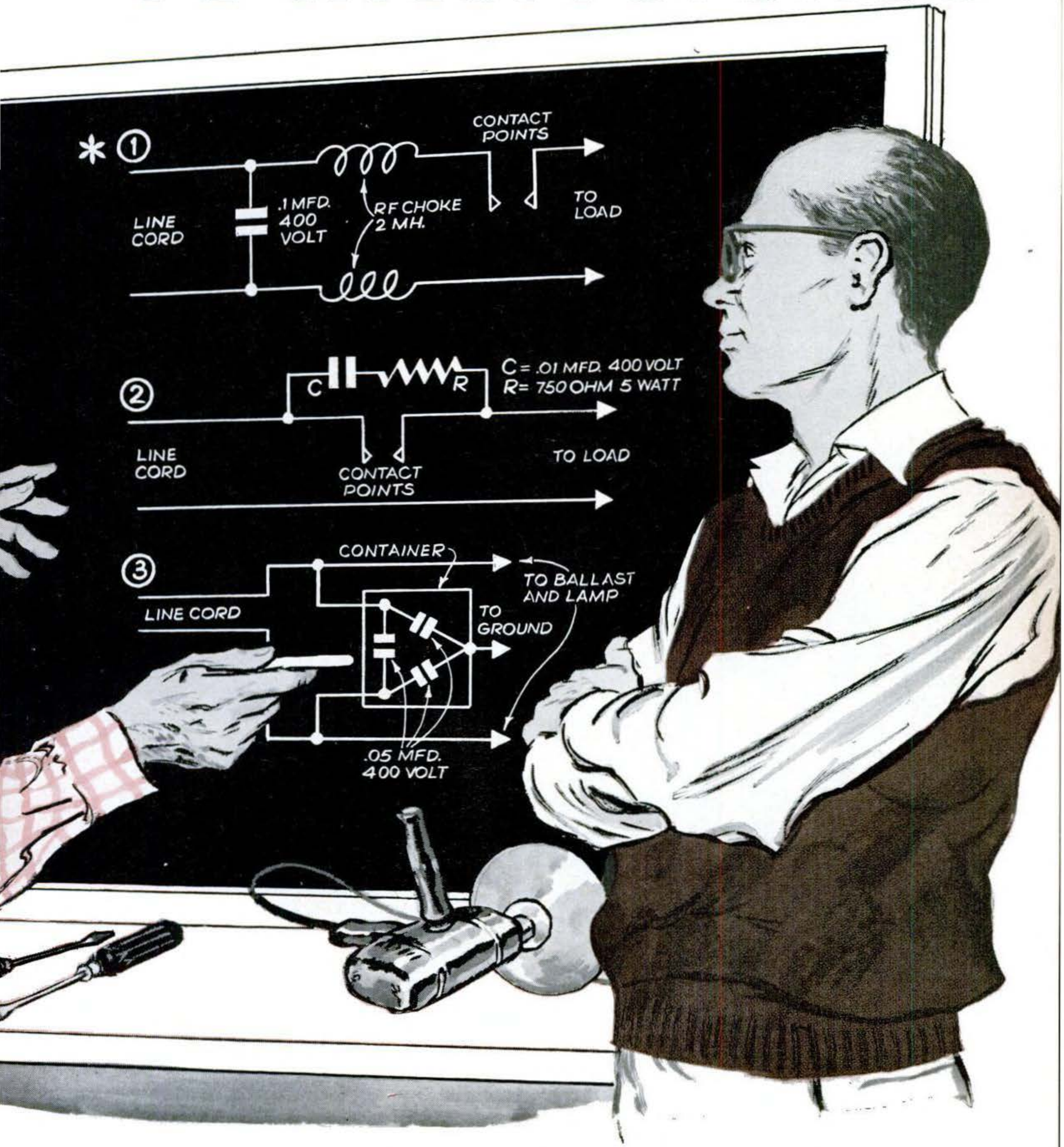
The Remedy for TV Interference



"Filters properly used will do the trick," said Cam Evans, rapidly sketching circuits on his chalkboard.

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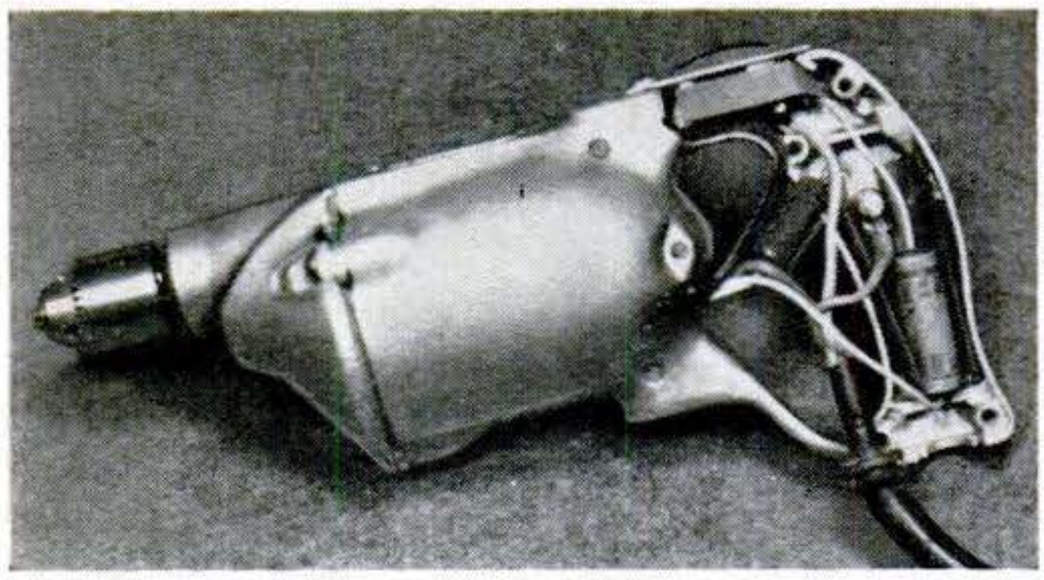
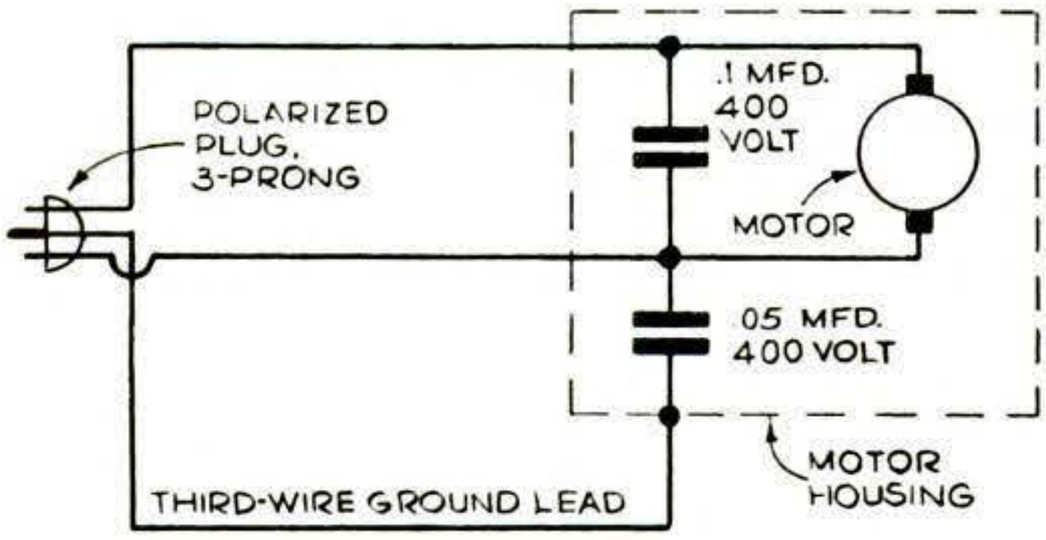
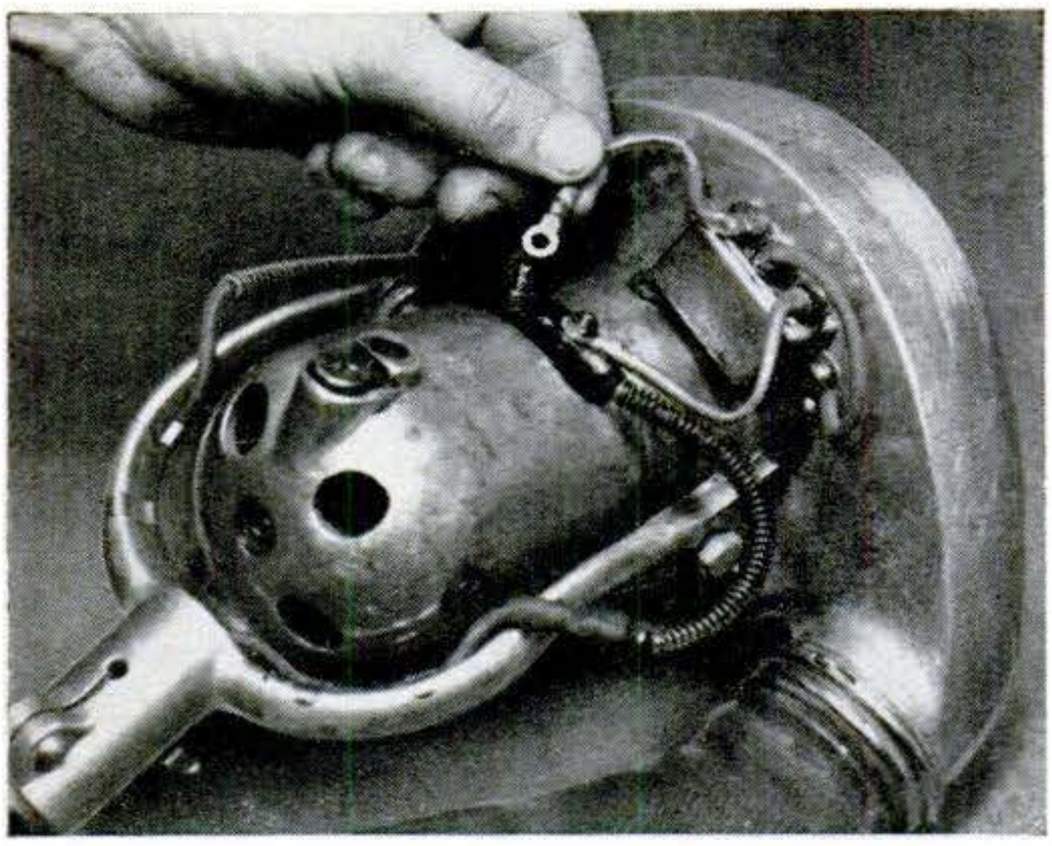
For metal-housed power tools

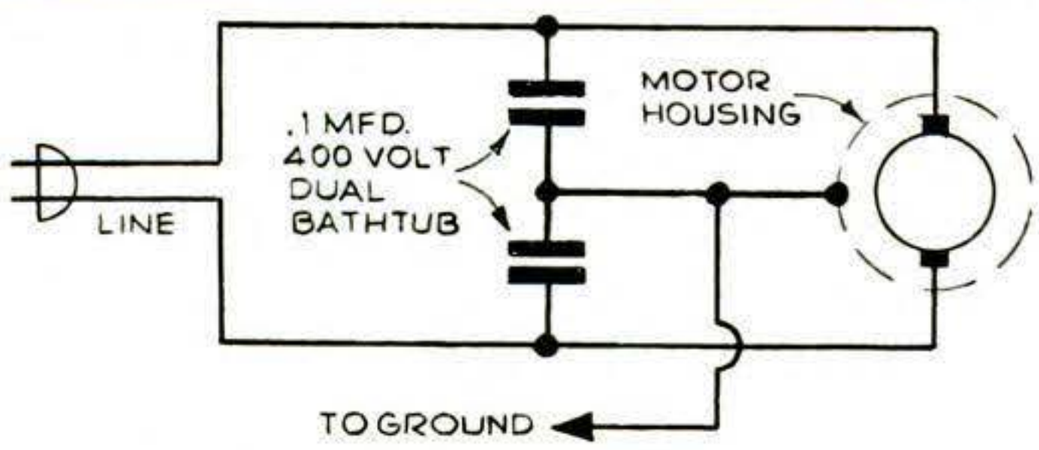




INSIDE THE HANDLE is the best place for power-tool filters. If space is cramped try the new midget condensers. Insulate condenser and leads so that they cannot short against frame. Use a ground lead. These condensers are suitable for all motor-driven home appliances.

For external mounting





READY-MADE FILTER UNITS are provided by metal-cased "bathtub" condensers. Dual unit shown here filters both sides of the line. Use a ground lead to the motor housing. Connecting condensers to frame may create a shock hazard if exposed metal is not properly grounded.

my troubles to my electrically minded neighbor, Cam Evans. I found him in his basement workshop.

"About Mrs. Perkins," Cam said when I had unloaded my problem, "she has an indoor antenna, making her set more sensitive to interference because of its weak signal strength. A filter or two should make everyone happy."

Plug-in filters. "It's Mrs. Perkins who needs a filter to keep her from interfering," I said irritably. Then, "As a matter of fact, Cam, I have been thinking of putting a plug-in filter on my TV."

"I don't know, Jack; they only filter the power that's feeding the set."

"So what? You're not trying to tell me that electrical impulses from a power tool can be picked up by a TV antenna?"

"Over a short distance, yes," said Cam. "A brush-type motor can generate a pretty strong signal. And with the power line for an antenna, it's a cinch to be picked up by a TV antenna close by."

"How about a filter at the shop outlet?"

"Might help in mild cases," he said. "A filter at the motor is best, though."

"But look, Cam," I argued, "a filter at the receptacle would isolate interference from the power line."

"Sure," he agreed. "But you still won't be doing anything about the motor cord, and that can radiate enough signal to foul up TV reception."

I should have known better than to argue. Cam hasn't spent years trouble-shooting for the local power company without learning the answers.

Our talk was interrupted by Bud Nolan, Cam's teen-age shadow who aspires to become an electrical wizard. He was holding a small radio in one hand.

"Hi, Cam. Hi, Mr. Foster," he called, waving with his free hand. "Not butting in, am I?"

"You are," said Cam. "But genius has its privileges, so get it off your chest."

"Okay. Listen to this." He put the tiny radio on a bench and plugged it in. "Built it with my own little soldering iron," he said proudly. As music came on to a background of uneven popping, Bud's smile turned to a frown. "Darn those beeping space satellites," he said.

"Guess again, Bud," said Cam.

"I know. I was only kidding." Bud glanced at the overhead fluorescent lamp. "It isn't the light or a motor. They cause

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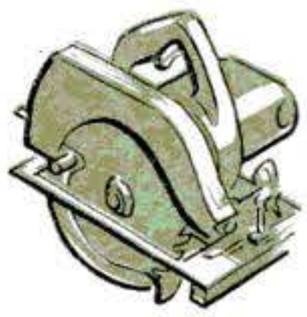
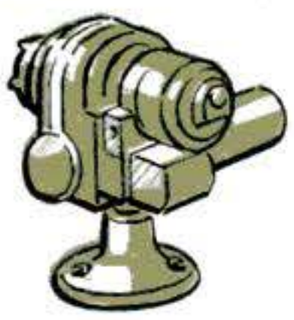
Where to Look for TV and Radio Interference and What to Do About It

Symptom	Probable Cause	Remedy
Rasping noises in sound; dots and streaks in TV picture	 **BRUSH-TYPE MOTORS** Portable power tools, vacuum cleaners, food mixers, sewing machines	Clean commutator, install new brushes, put in condenser-type filter. CAUTION: Use no larger than .05 mfd. condenser to ground. Be sure all exposed metal housings are securely grounded with separate ground wire
Rasping or popping noises; dots and streaks. Picture may flip. Usually occurs during starting cycle only	**INDUCTION-TYPE MOTORS** Air conditioners, refrigerators, furnace blowers, washing machines, dryers	Bond motor to frame, install direct ground, check for loose connections, check starting mechanism
Clicks, popping noises in sound. Picture may flip in weak signal areas	**THERMOSTATICALLY CONTROLLED HEATING DEVICES** Electric irons, coffee pots, skillets, heaters, blankets, pads	Check line cord and connections. Install choke-type filter at outlet. Put in condenser-resistor filter across contact points of thermostat
Roar with distinct low-pitched hum when furnace comes on. Streaks and flipping in TV picture	 **OIL-BURNER IGNITER**	Bond motor, burner and furnace. Install choke-and-condenser filter on igniter
Frying noise. Salt-and-pepper effect in TV picture of nearby sets using indoor antennas	**DOORBELL**	Install resistor-condenser filter across contacts at bell. Replace transformer if defective
One or two dark, snaky lines across the picture, usually on only one channel	**OLD-STYLE TUNGSTEN LAMP**	Replace with modern bulb
Popping or crackling noise in AM radios. Flashes and streaks in TV picture	**BELT STATIC** Any belt-driven device	Bond machines together with heavy conductor and ground. Apply thin film of graphite to belt
Rasping or frying noises in AM radios. Overall sandpaper effect in TV picture	**FLUORESCENT LIGHTS**	Replace starter and fluorescent tube. Install condenser-type filter in lamp housing. Use special commercial filter in severe cases

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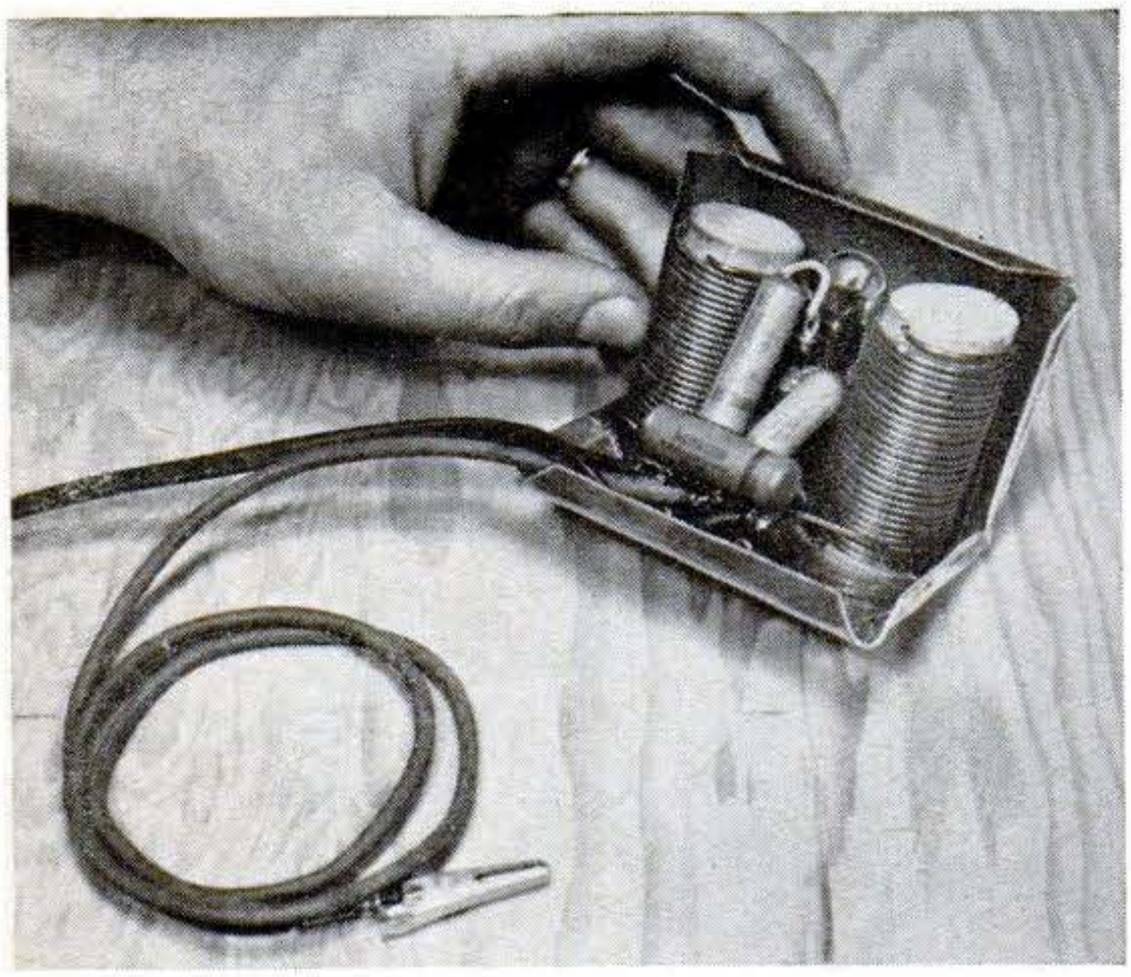
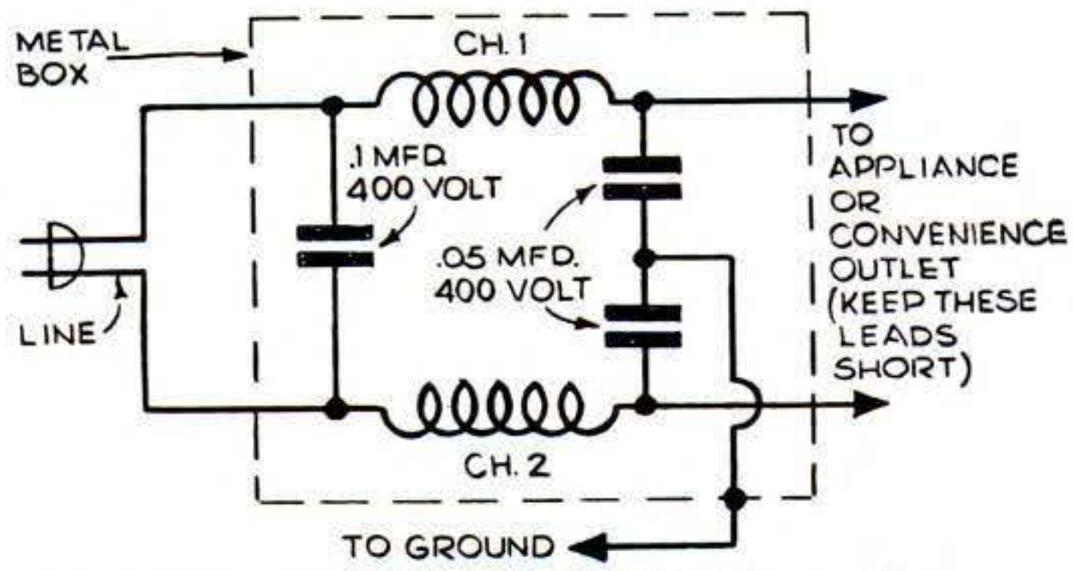
Combination choke-and-condenser filter fits in box





EVEN STUBBORN CASES of TVI will usually be cured by this combination choke-and-condenser filter. House in a separate box. Chokes 1 and 2 in circuit above consist of 18′ of No. 20 enameled wire wound around empty thread spools. Filter is suitable for appliances requiring not more than 500 watts. If the power demand is greater, use larger size wire.

a steady buzzing." He scratched his head. "Got it! Mrs. Cam is using one of her automatic electric gadgets."

"Good try," Cam agreed. "Some thermostat-controlled appliances do cause radio popping. But you aren't even warm —and that's a clue."

"Warm—furnace?" I suggested.

"Too easy, Mr. Foster," Bud said. "That's an induction motor Cam's got running the furnace blower, and they don't cause radio interference—much."

"Right," Cam agreed. "How about the drive belt?"

"Static!" Bud was elated. "That's it—static discharge from the belt!"

Discouraging static. Cam nodded. "I was just about to fix it. A thin film of graphite on the belt, and a good ground on both motor and blower will discourage the static build-up."

"How about power lines?" I asked knowingly. "They get the blame for a lot of static in radio and TV sets."

"Unjustly, Jack, unjustly," said Cam. "Power systems would come at the bottom of a list of interference sources."

"And what about tree limbs rubbing against power lines?" Bud chimed in.

Cam held up his hands. "Wait, now, you two. The power companies *want* you to get good reception. A lot of people who yell the loudest make their own interference. Out-of-date wiring, for instance, and a lulu we came across recently . . ."

"Induction-heating equipment, I'll bet," Bud broke in.

An old-timer. "Not that simple," said Cam, taking a clear light bulb, obviously an old-timer, from a drawer. "Not many of these straight tungsten-filament bulbs around, but just one of them sure can mess up a lot of TV reception."

"What's the story?" I asked.

"Well, a whole two-block area was complaining of wiggly lines across the picture. We had to make a house-to-house search before we found the culprit—this bulb. A woman forgot to turn it off in an attic."

"Interesting, Cam," I observed, "but wouldn't you say that shop tools are a more common cause of interference?"

Cam laughed. "Okay, I can take a hint." He put the bulb away and went over to his chalkboard.

"Filters properly used will solve your TVI—television interference—problem, Jack," he began, sketching circuits as he talked. "No one filter is a sure cure. Commutator motors are the worst offenders, especially if the brushes are worn or the commutator is rough. If cleaning the commutator and installing new brushes doesn't do the job, a filter will—in most cases a simple condenser filter."

"What other kinds are there?" I asked.

Unknown source. "The combination choke-and-condenser filter used on equipment causing severe TVI." He pointed to a circuit. "A filter like this in the TV power cord will sometimes cure TVI from an unknown source if the power line is the carrier. But it takes a special antenna filter for disturbances picked up by the antenna."

Bud had been studying the circuits.

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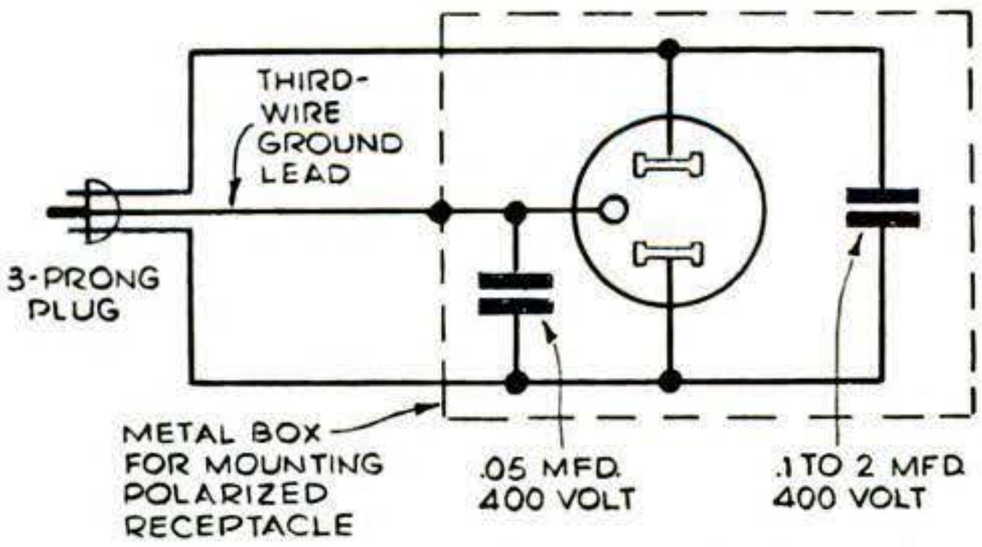
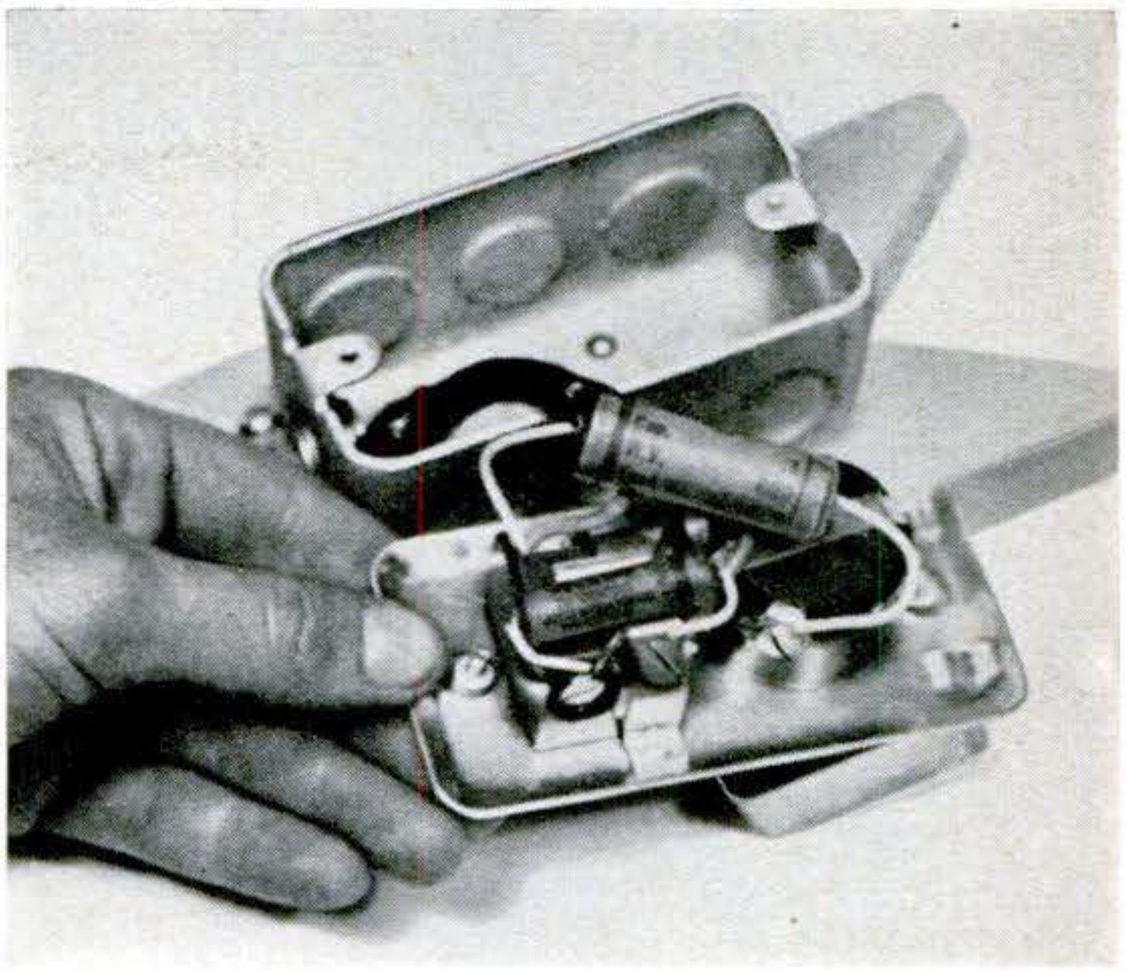
An emergency filter for borrowed or rented tools





ALL-PURPOSE FILTER, assembled in a metal receptacle box attached to an extension cord, is good for use where installing a filter at the power tool is not practical. This make-do setup is not quite as effective as a built-in filter because the tool cord may still radiate some interference. Winding the cord and tying it into a short hank will help some.

"Don't those condenser filters need a grounding circuit?"

"That's right," Cam agreed. "It lets the filter condenser bleed off electrical interference generated in the motor. A direct ground improves the efficiency of most types of filters."

"But what if a tool or appliance can't be grounded?" I asked as Cam erased the circuits and drew some others. "Can you picture a woman bothering to ground her vacuum cleaner?"

"You've got a point there, but if the appliance still causes interference, simply reversing the line cord in the outlet will often do the trick."

Bud picked up his radio. "That's for me," he said. "Mom's sewing machine gives my radio the jitters."

The filter I put together that afternoon seemed to work, but before attaching it permanently to my sander, I brought it over to Cam for a check. Just as he finished running leakage tests, Bud came clattering down the stairs.

"It blew up," he announced excitedly.

"What blew up?" Cam asked.

"The filter I put on Mom's sewing machine. It was a 20-mike electrolytic condenser in parallel with the brushes . . ."

"Oh, no, Bud," Cam broke in. "Not a 20-microfarad electrolytic?"

"Sure, Cam. The bigger the condenser the better the filter."

"Do you remember what condensers do in a radio?"

The boy pondered, and suddenly clapped a hand to his forehead. "Boy, am I a dope. Why, that 20-mike job was practically a short circuit across the line."

When I looked puzzled, Cam explained, "Electrolytics are designed to be used only with DC. The reverse polarity from AC current broke down the insulating film in the condenser. And even if the insulation isn't ruptured, those big condensers can pass a lot of AC power."

"Then how can they filter anything?"

Condensers are choosy. Bud took the floor. "You see, Mr. Foster, condensers are choosy about the frequencies they'll pass. Small condensers act like an open door to pass off high frequencies that cause interference, but like a tiny crack when it comes to letting the 60-cycle power frequency through."

"Bud's right," Cam said. "Motor brushes create a high-frequency electrical surge in the power line every time they contact a commutator segment. Small condensers bypass these interference-makers to the ground before they have a chance to travel along the power line."

"Yeah," said Bud sheepishly. "I should have remembered that the frequencies a condenser will pass vary with its size."

"This is all dandy for you and Bud," I said, "but what about my problem?"

"Yours is solved, Jack," Cam said, handing me my filter assembly, "except for one thing."

"Oh?"

"If I know Madge, she'll want a filter on each of her appliances so that she won't miss any TV programs while doing the housework." END

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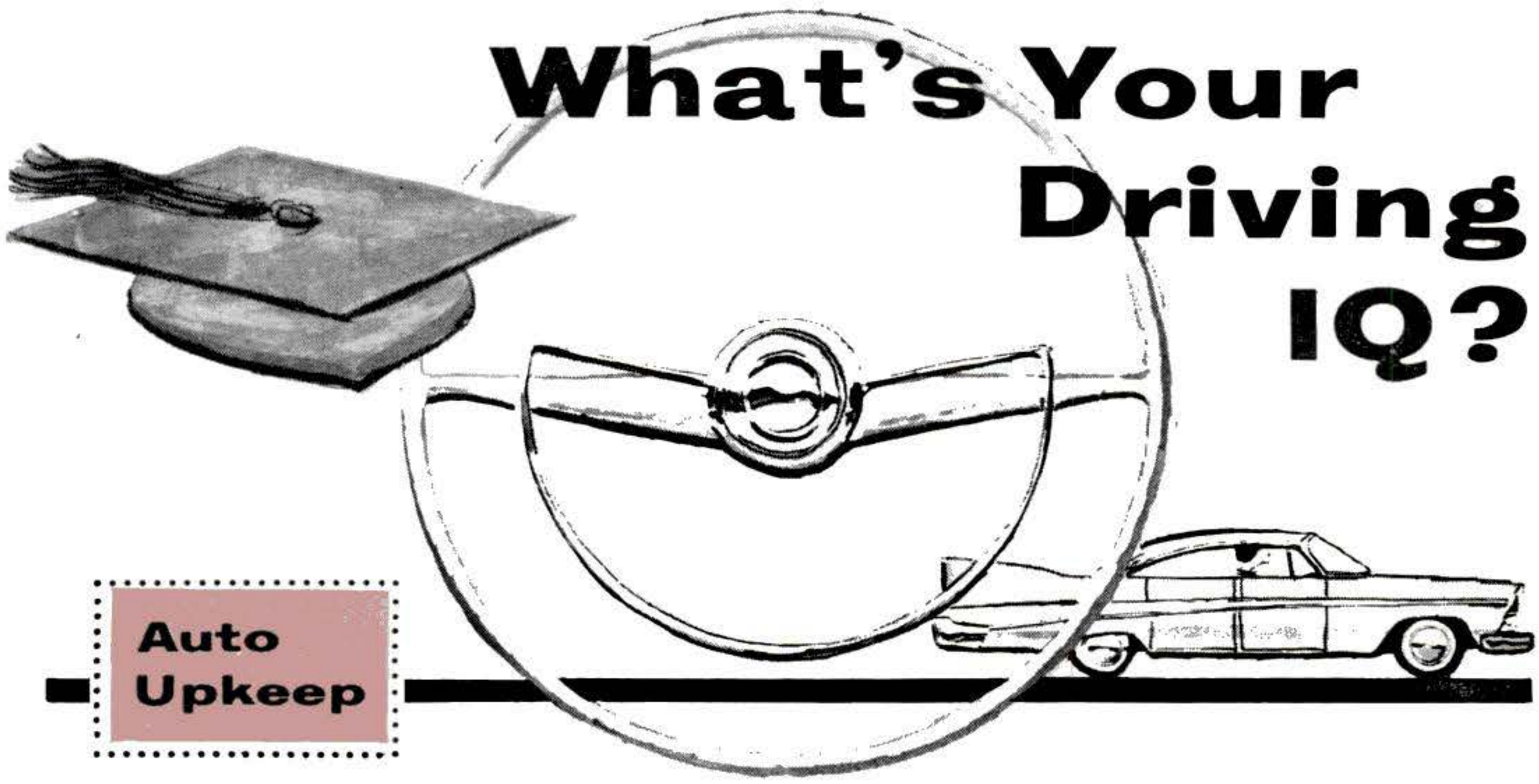
What's Your Driving IQ?



Auto Upkeep

Study these 10 statements, then test your car sense by marking them "true" or "false"

1 When an engine equipped with automatic choke does not start right away, keep pumping the gas pedal to prevent flooding. ☐ TRUE ☐ FALSE

2 If you are abreast of a car you intend to pass and suddenly find the road is not clear, let up on the gas and apply the brakes, instead of trying to shoot ahead. ☐ TRUE ☐ FALSE

3 Lubricating oil should be changed more frequently in dusty conditions. ☐ TRUE ☐ FALSE

4 When an engine "pings" under acceleration, it is giving full power. ☐ TRUE ☐ FALSE

5 After a long, hard drive, it is good practice to let the engine idle for several minutes before you turn off the ignition. ☐ TRUE ☐ FALSE

6 Crankcase oil should be drained while it is warm, and after a car has been run. ☐ TRUE ☐ FALSE

7 When tires check about four pounds over the recommended pressure after being driven at highway speeds on warm days, do not reduce the pressure. ☐ TRUE ☐ FALSE

8 If most of your driving is in stop-and-go traffic, and you take it easy on the highways, your car can use spark plugs that are a little hotter than normal. ☐ TRUE ☐ FALSE

9 During warm weather it is a good idea to fill the gas tank at the end of a day. ☐ TRUE ☐ FALSE

10 Driving today's high-compression, high-horsepower cars above 60 m.p.h. is poor economy. ☐ TRUE ☐ FALSE

Now score your driving IQ. For the answers and the "reasons why," turn to the next three pages

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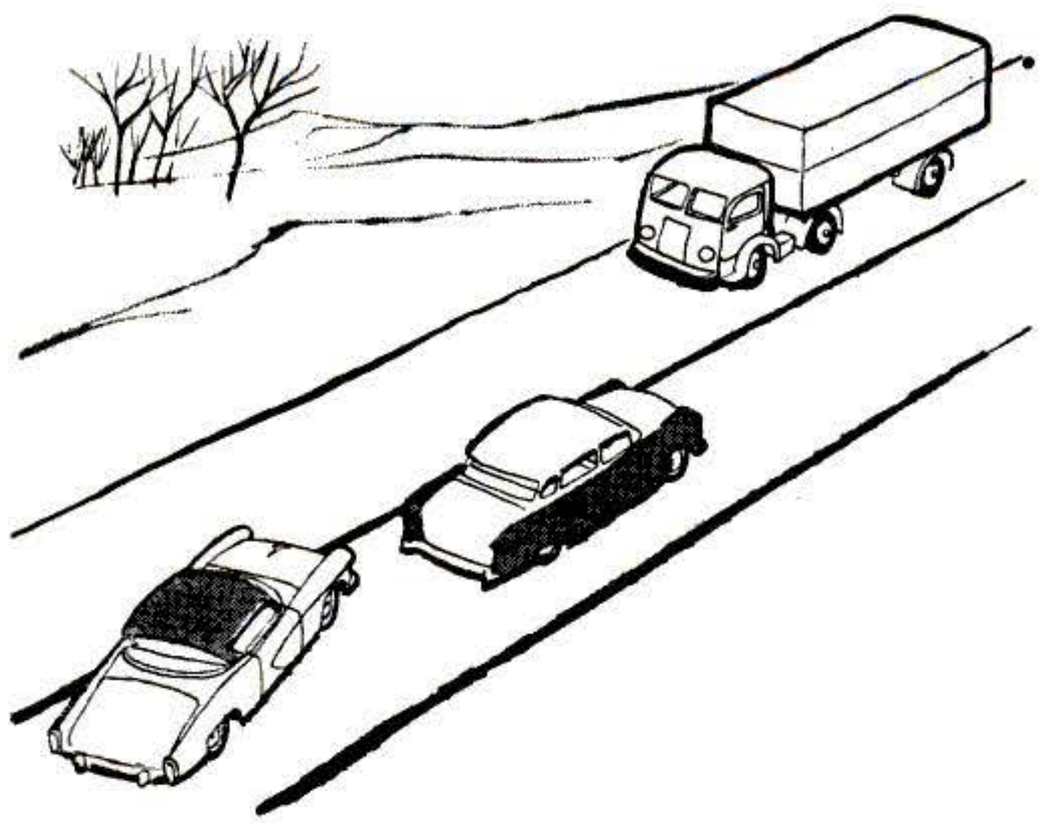
Knowing the right answers can add to your

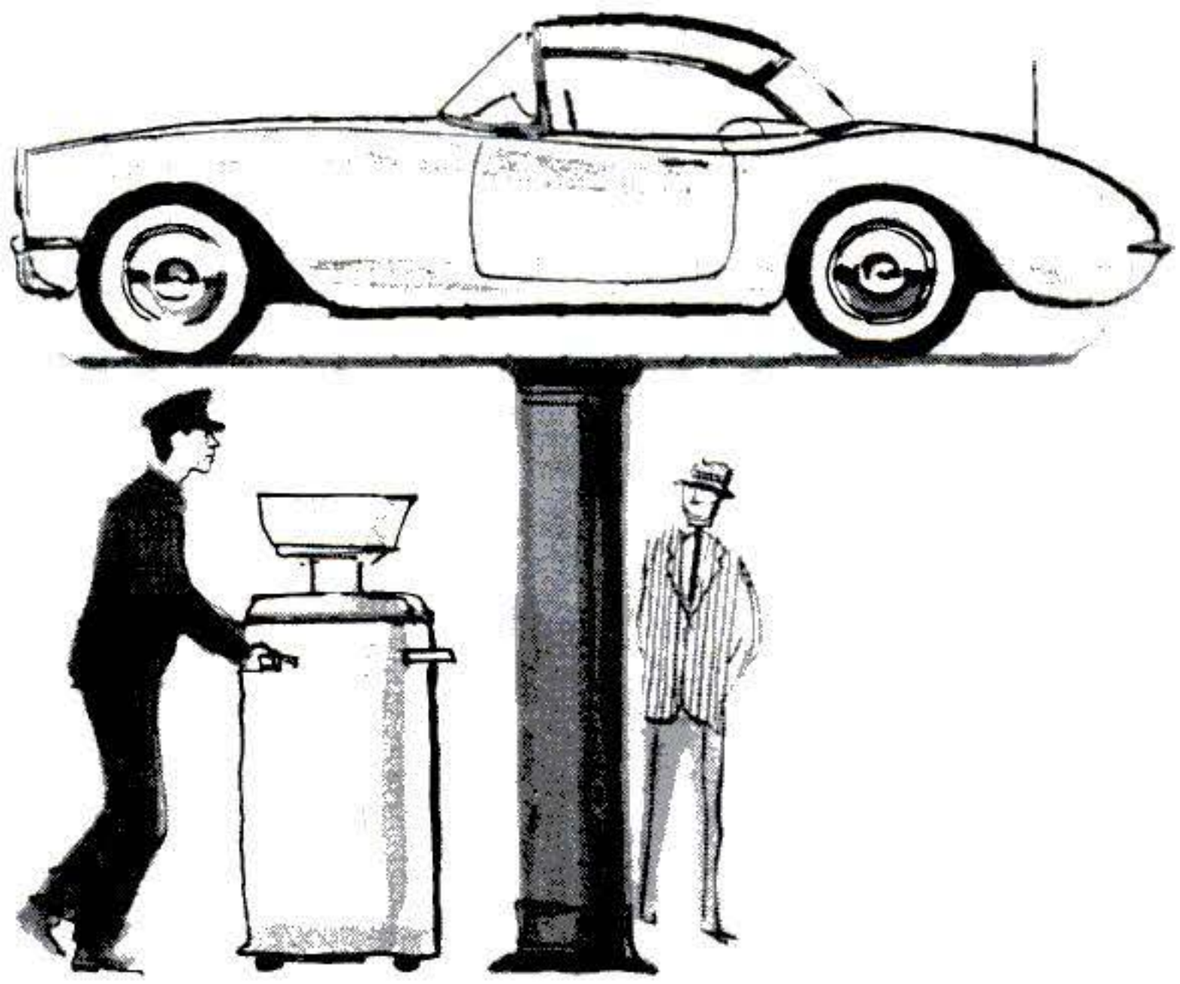
1 FALSE. Priming more than once or twice with the gas pedal floods the engine, making it impossible to start until the excess gas is cleared. To overcome flooding, push the gas pedal clear down while using the starter. This will "unload" the choke valve enough to allow air through the carburetor without picking up excess gasoline. The unloader is built into the carburetor and functions when the throttle is opened wide.

If the car is still flooded and refuses to start, hold down the gas pedal but stop cranking the engine. If your starter works with the foot pedal, turn off the ignition. Wait a few minutes and use the starter again. By keeping the gas pedal down, you do not pump gas into the engine while depressing the accelerator to use the starter. Never crank the engine for more than 25 or 30 seconds, as this may heat and damage the starter. Never let the starter run the battery clear down.



2 TRUE. Using the brakes and reducing your speed makes it possible to get back in line much quicker than you could squeeze ahead with full throttle. Braking power is far greater than accelerating power at passing speeds. By reducing your forward speed, you lessen the impact in case of collision. Also, if you try to crowd ahead you may cut off the car you are passing and cause a three-car pile-up.

There is one exception. If you see that the driver of the car you are passing is aware of your danger and uses his brakes to slow down, then use full power to slip in front.



3 TRUE. Dust is an engine's worst enemy. If you regularly drive over unpaved roads, dust gets into the engine through the air cleaner and crankcase breather, and eventually mixes with the oil. Only by frequent oil changes—as often as every 500 miles—can you be sure of minimizing engine wear caused by dust's abrasive action. Filters, too, should be changed more often than recommended under such driving conditions.

The second menace to an engine's long life expectancy is contamination of the oil from condensation, producing low-temperature sludge. If you use the car only for short trips of a few miles to and from work, or for stop-and-go city driving, oil should be changed once a month, even if the mileage is as low as 100 between changes. The more times an engine is started and has to warm up—especially in cold weather—the more the oil is diluted by condensed vapors. An occasional run on the highway will evaporate these vapors before they form harmful acids, so when short trips are combined with highway travel now and then, oil changes can safely be stretched to 1,000-mile intervals.

If your average trip is 20 miles or more at speeds that keep the engine operating at normal running temperature, the mileage between changes can be upped to the factory-recommended intervals of three to five thousand miles, depending on the make of car. Under these conditions, use a top-grade oil, and change the filter at least every other oil change.

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4 **FALSE.** An engine "ping" or "knock" means not only that it is wasting power, but that the moving parts are being overloaded. The sound is caused by too rapid combustion of the gasoline, which detonates, or explodes, instead of burning. A sudden jolt is imparted to the piston without any follow-through for the power stroke. This results in terrific pressures, increasing combustion-chamber temperatures that can harm valves, pistons and rings, as well as spark plugs and rod bearings.

There are several ways to prevent "ping." Shift to a lower gear; use passing gear on hard pulls; change to higher-octane fuel; reset the ignition timing. If your engine is heavily carboned, it may be necessary to remove the head and clean out the combustion chamber.

5 **TRUE.** A short idling period gives the engine a chance to get rid of the extra heat developed during a hard drive. An idling engine creates less heat than one at higher speeds, under a load; and it cools down naturally. Uneven cooling of metal when a hot engine is shut off may cause damage to valves and other internal parts.

If the temperature gauge registers overly hot, stop the car facing into the wind, raise the hood, and let the engine idle until the gauge drops. Check the coolant level to see that it's not low.

6 **TRUE.** Driving a car for at least half an hour, and longer in cold weather, warms and stirs up the oil. This mixes the loose particles of dirt and carbon, and keeps moisture and acids suspended, so that they will all drain out with the old oil. The main reason for changing oil is to get rid of these harmful substances, and the more that can be drained out, the better service you will get from the new oil. It will have less initial contamination.

7 **TRUE.** Tires build up pressure at high speeds and during hot-weather driving. This is a normal condition and so long as the tire pressure was correct at the start of a trip, the increase in pressure should not be reduced.

Inflate tires to the recommended pressure when they are cool. Ordinary driving friction will raise the pressure about two pounds. After a fast drive, correctly inflated tires will check four to five pounds over cool pressure. So if your tires need air after you've been driving around town, put in about two pounds more than recommended. On a highway trip, if tires seem low or squeal excessively on turns or when braking, add an extra four pounds. Otherwise the pressure will be too low when the tires cool.

8 **TRUE.** To perform efficiently, spark-plug firing tips must operate within a specified temperature limit. Slow town driving, with idling in traffic, may drop the firing-tip temperature low enough to be within fouling and carbon-forming range. If you don't do much fast driving, which would burn away these accumulations, frequent cleaning will help prevent misfiring, and the next-hotter plug will give you longer and more efficient service. A hot plug with its longer firing tip cannot dissipate heat as readily as a short-tipped plug, and carbon deposits burn off at lower cylinder temperatures.

The fouling condition results in dark, dry carbon formation on the electrodes, insulator tips and metal parts, unlike oil-fouled plugs, which have a wet, oily carbon on the exposed parts.

If you drive mostly in city traffic, and don't speed on the highways, your car probably will do better with plugs one step hotter than recommended for normal driving.

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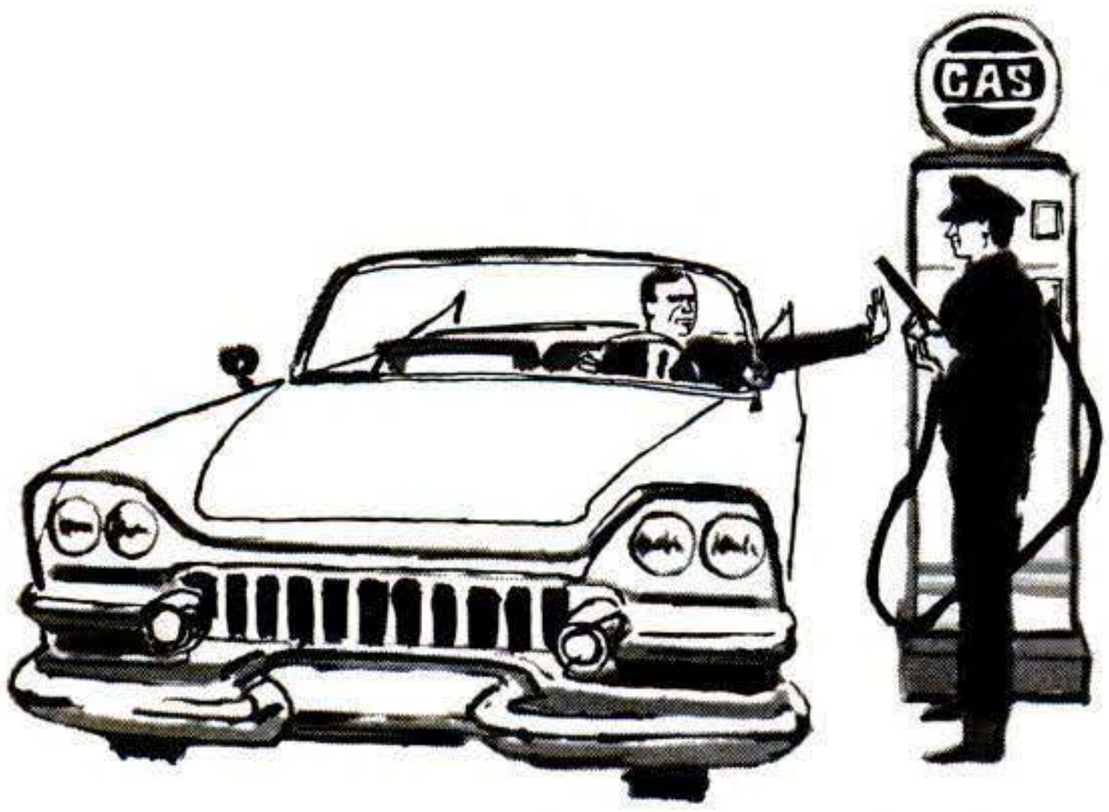
Good driving habits add to your car's life



9 **FALSE.** Filling the tank at the end of a day may save you a few minutes on the next morning's start, but it will come out of your pocketbook. Gasoline expands during the heat of the day. When it cools in your tank at night, it will shrink, and in the morning you'll have less than you paid for, even though the full number of gallons were pumped in through the meter.

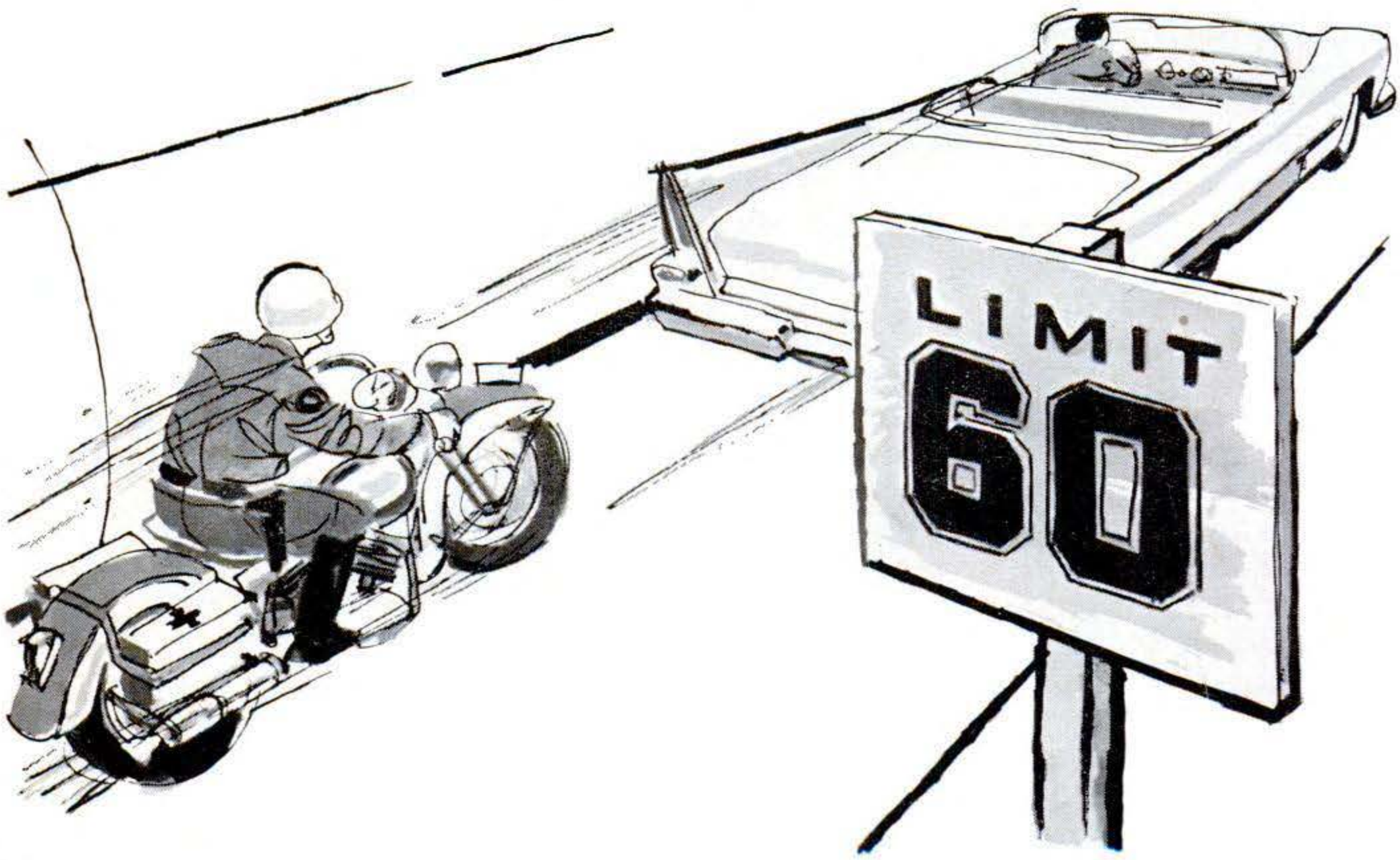
10 **TRUE.** Although today's cars will maintain high road speeds, it is still poor economy to go faster than 60 m.p.h. Gas mileage is sacrificed for speed and power when you push the needle much over 45. Your car may give 18 miles to the gallon at a steady 30 m.p.h., but drop to around 12 miles to the gallon at 60. Above that speed you put more wear and tear on the brakes, and every time you use the brakes some of the gas mileage you paid for is eaten up. Then, as you open the throttle, gas pours through the carburetor and more mileage goes out the tailpipe.

Faster tire wear is another penalty of high speed, both from increased friction and the greater amount of acceleration and braking.

Safety, translated into terms of doctor and repair bills, is another factor. With a powerful and easy-riding car, the speedometer can climb to 70 or 80 before you know it. Too late you may find yourself without room to stop, or approaching a curve at a speed too great to hold the car on the road.

Then, too, high-speed driving uses up more oil, and deceleration pumps extra oil by the piston rings; moving engine parts get more wear; the chassis takes a greater beating.

It is poor economy to pay this extra cost of fuel, tires and repairs, while taking unnecessary chances. You can still make good time on the highways without topping 60 m.p.h.—*Robert V. Thompson.*



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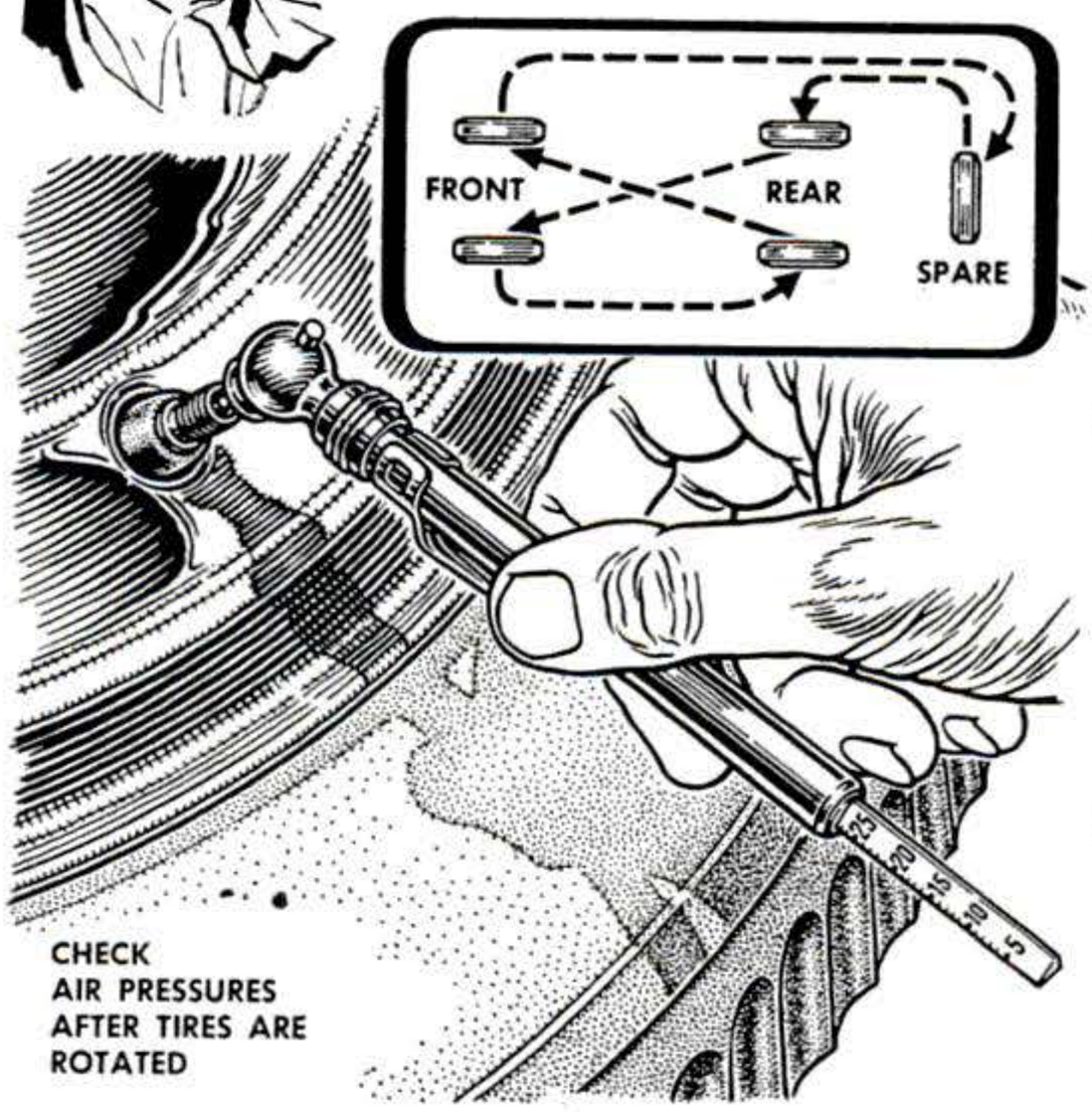
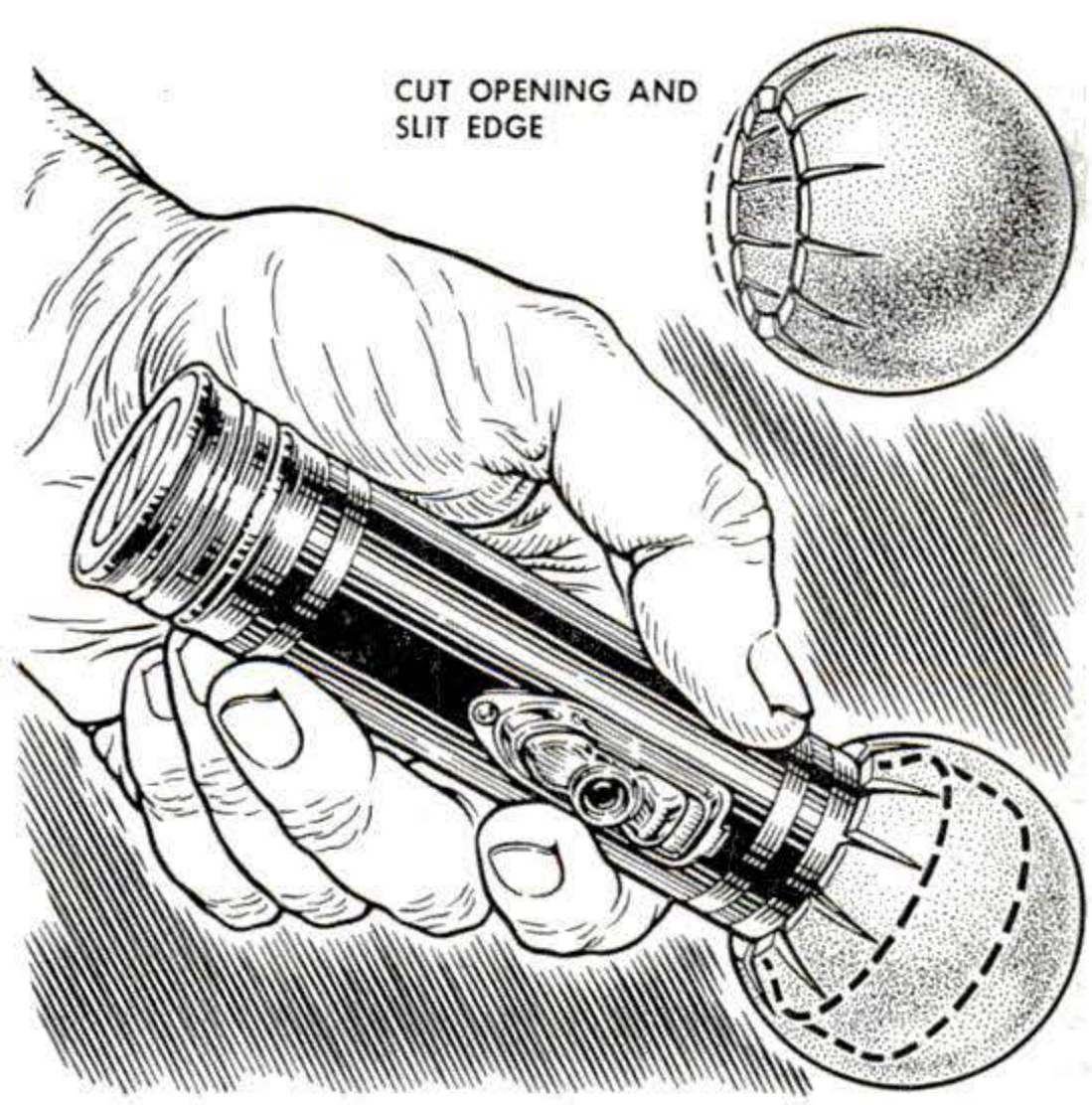
Hints from the Model Garage



After switching tires, remember to check pressure in the new position. Front tires should carry a few more pounds than rear, and rotating puts the softer rear tires up front (see rotation chart above) where they may prove to be underinflated.

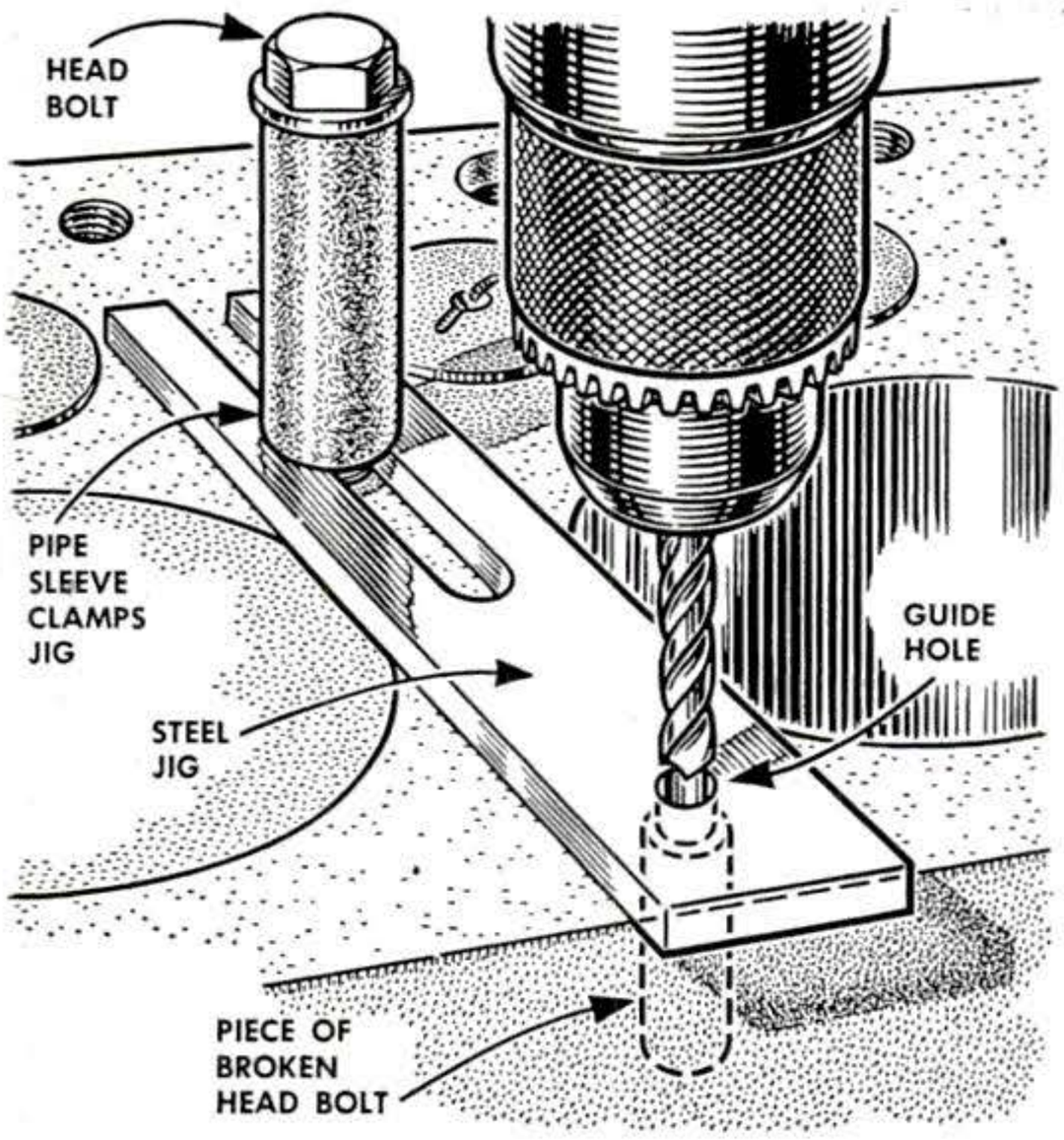
Checking door-lock buttons to see that they're down can be done with a glance if you put a band of red paint or colored tape on them. When the buttons are pressed down, the bands disappear. If you can see a band, the door is unlocked.

A good makeshift creeper for work beneath your car can be had from a large carton opened flat. It can be shifted about easier than papers or a cloth and the thick board gives your back protection from damp or greasy ground or concrete.

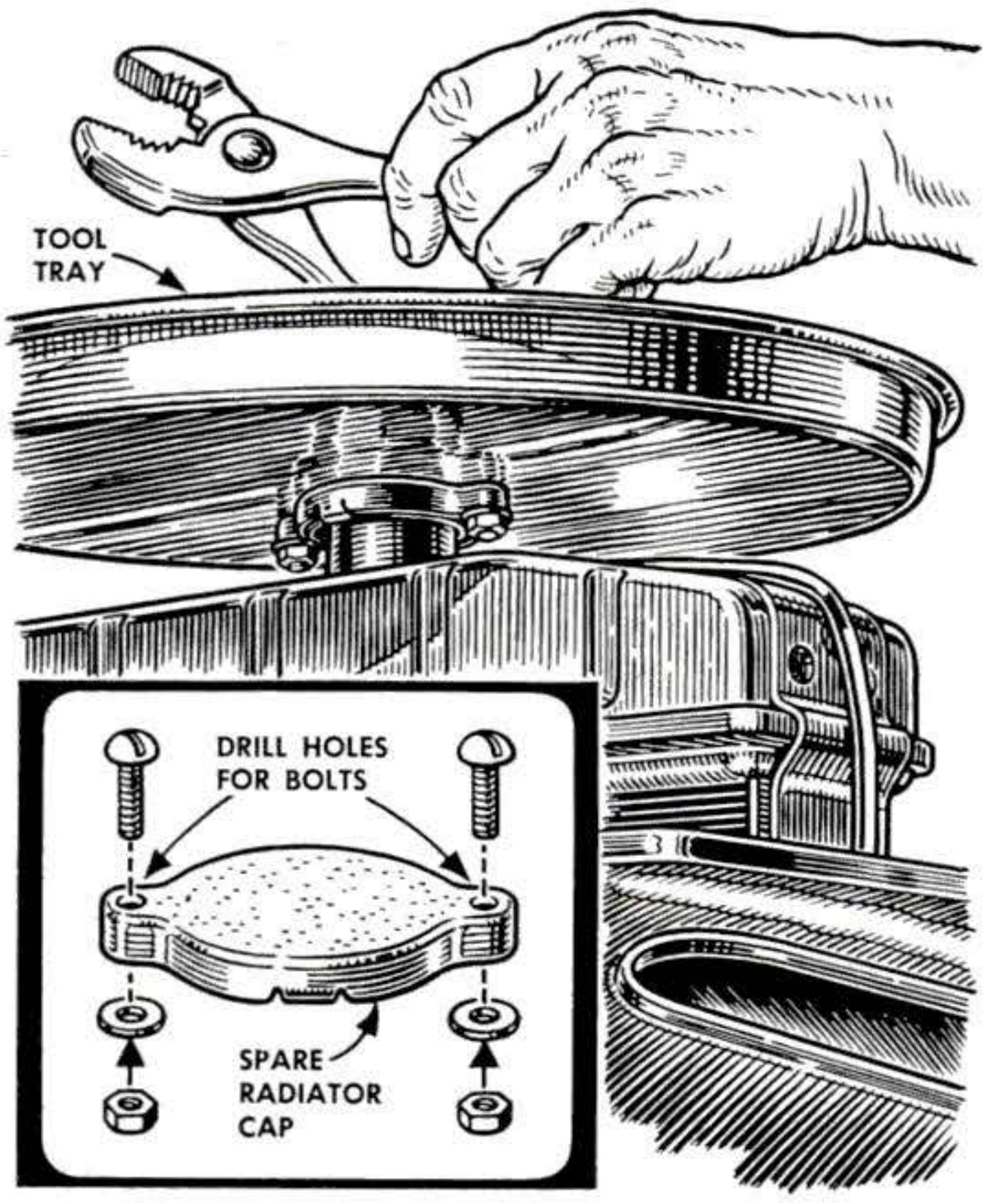


Cap the lens of a flashlight with a rubber ball to protect it while being carried in the trunk, glove compartment or tool box. Cut an opening in the ball, then slit the edge of the opening so it can easily be forced over the lens of the flashlight.

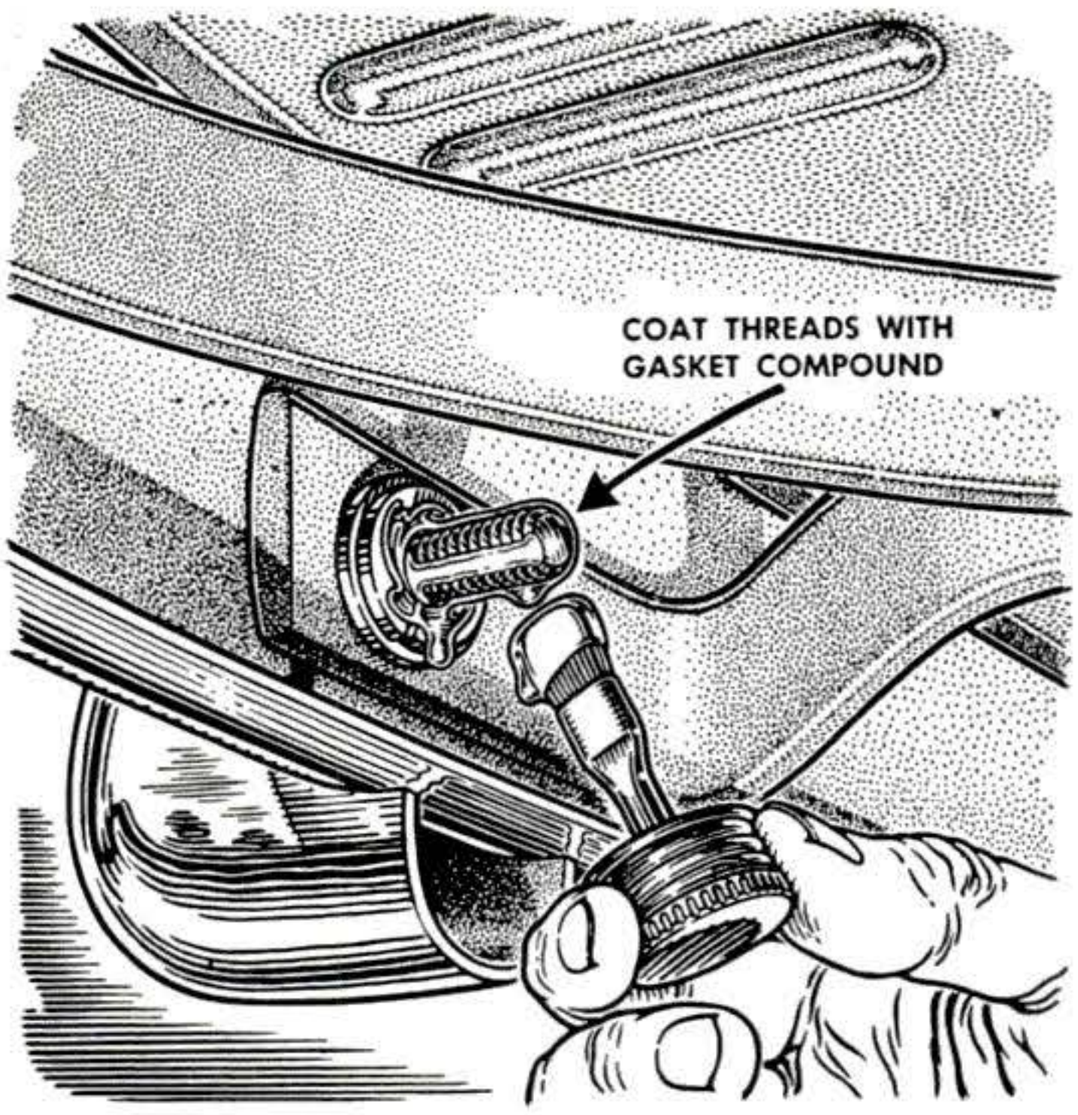
More Hints from the Model Garage



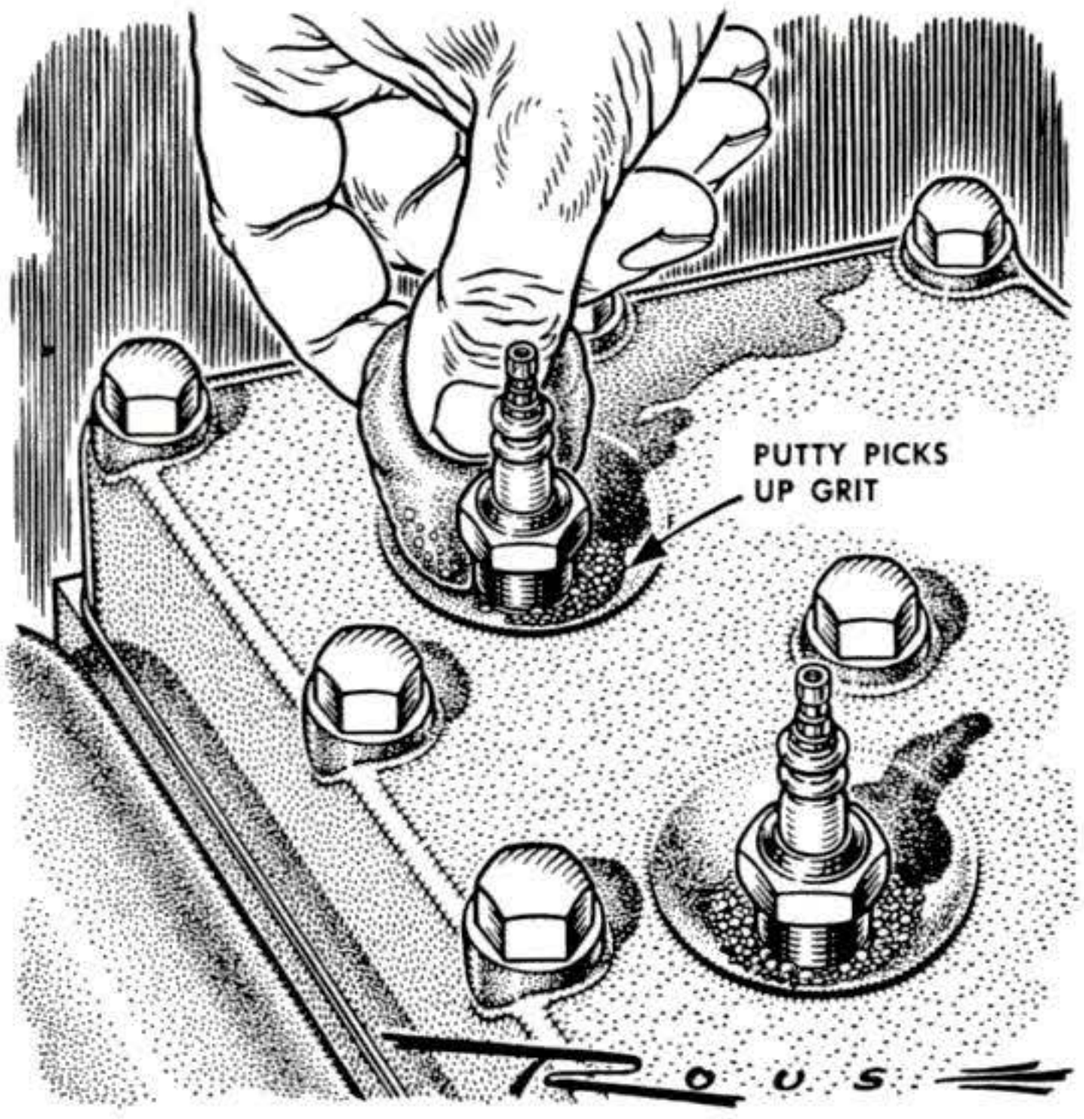
To drill out a broken bolt without damaging the threaded hole, clamp a simple jig under an adjacent bolt to center the drill. To make the jig, cut a slot in one end of a steel strip and drill a guide hole near the other end for the drill bit.



A tip-proof tool tray can be made by bolting a large pie tin or serving tray to the top of a spare radiator cap. Mounted on the radiator's filler neck in place of the regular cap, the tray is handy as you work in the engine compartment.



A coating of gasket compound over the protruding end of a bolt exposed to the weather will keep it rust-free and easy to remove. Protect license-plate bolts this way, and coat bumper-bracket bolts, fender and body bolts when new.



Pick up dirt and grit from spark-plug wells, so plugs can be removed without contaminating the cylinders, with a ball of putty or wallpaper cleaner. Press it in firmly, close to the plug. When you lift it out, the grit will adhere to it.

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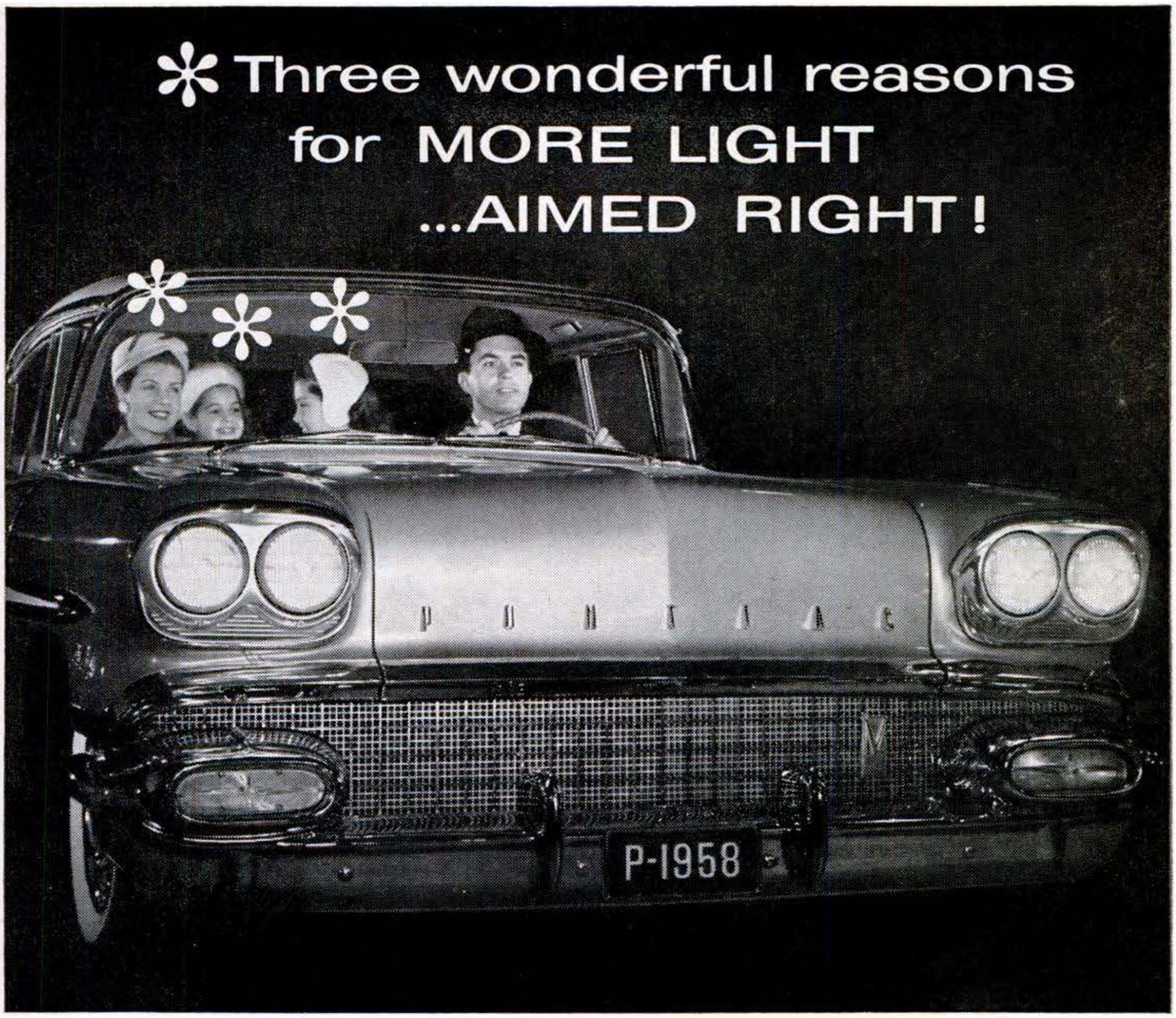

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Three "Guide Points" on the face of each T-3 lens are ground to tolerances within one ten thousandth of an inch. This precision, and the simplicity of the T-3 aiming method, assure you of MORE LIGHT—AIMED RIGHT . . . more safety for both you and your family.

If the headlamps in your car are two years old or more, have them replaced with new Guide T-3s now. And have your headlights aimed at least twice a year.

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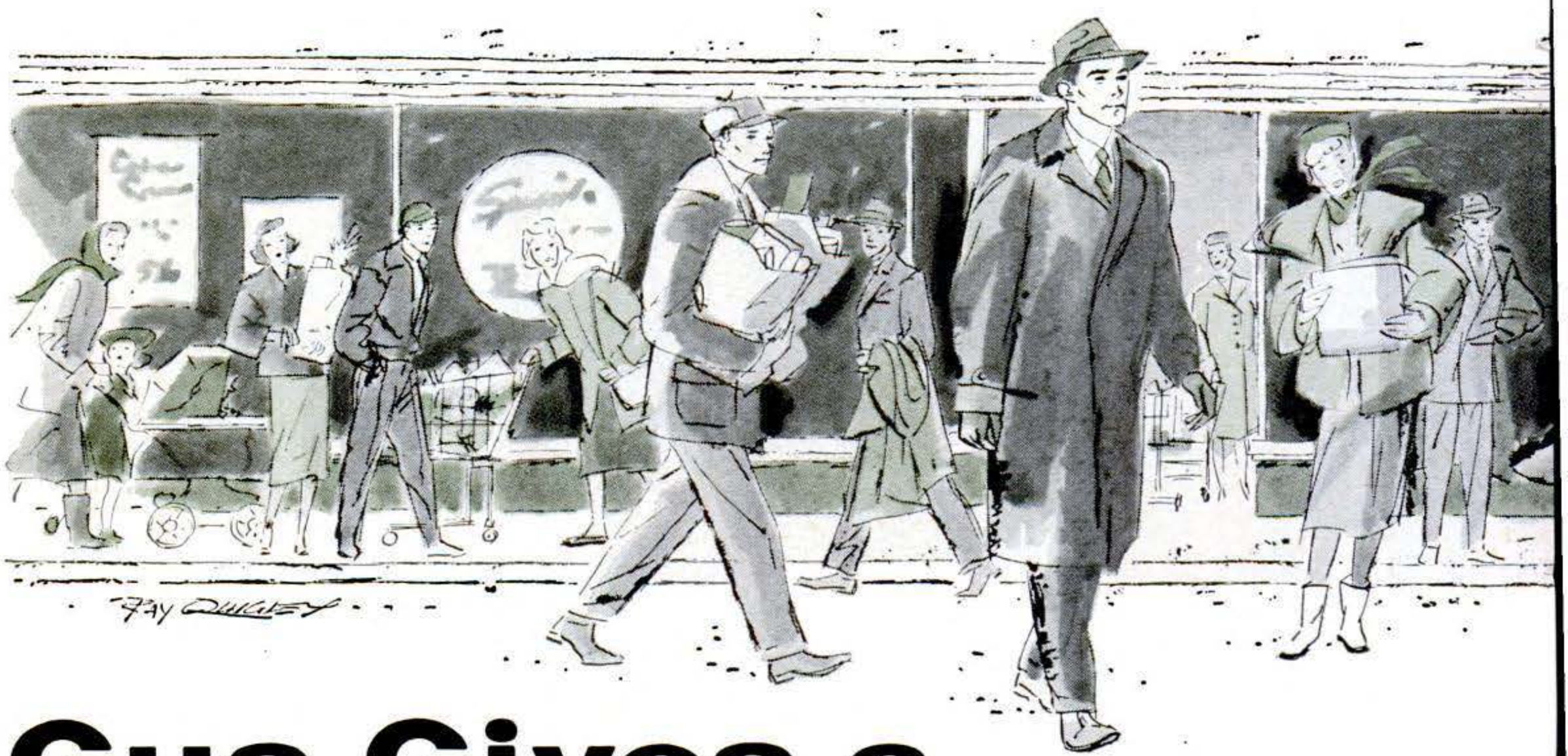
Just overhauled by the town's new mechanic, Stafford's car was stone-cold dead at the market



Gus Gives a Competitor the Business

By Martin Bunn

WALT SOMMERS, the local plumber, was jubilant when he telephoned Gus Wilson at the Model Garage, to inform him that Oliver Stafford required his services. Stafford was out at the new shopping center, which had sprung up in the suburbs like a mushroom in lush soil.

"I warned Stafford not to have his car overhauled by a Johnny-come-lately like Paul Ryberg," Walt crowed. "I tried to get him to take his work to you, but he wouldn't listen. Now his newly overhauled motor is out here on the shopping-center parking lot, stuck tighter'n a glacier in Alaska. Get out here fast, Gus, and take over."

"It seems to me," Gus said, "that the man to call is the fellow who did the overhaul. Why don't you give him a ring?"

"Are you nuts, Gus?" Sommers inquired. "You've been in the garage business around here for years and now these newcomers like Ryberg are out to cut your throat. This is your chance to show Ryberg up."

"What have you got against this man?" Gus asked the plumber.

"Nothing," Sommers said. "Absolutely nothing. I hardly know him. But with all this new building in the suburbs, it's up to us old-timers to hang together. I'm a plumber and you're a mechanic. If we don't work together to beat down new competition, we're sunk."

"If Paul Ryberg did Stafford's overhaul," Gus insisted, "he's the man to call in on this."

"That's just it," Sommers said exultantly. "Ryberg's away on vacation. Any-

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Gus began to remove the spark plugs. Nothing happened until ***he took out the third one.***

way, Stafford's so mad about this now that he wouldn't call him if he could. In fact, he asked me to call you."

"In that case," Gus agreed, "I'll be right out."

WHEN Gus arrived at the shopping center he found that Stafford's stalled car was attracting considerable attention. People going in and out of the various stores were stopping to ask questions and offer advice. It occurred to Gus that if Paul Ryberg's overhaul job had indeed gone sour, he was in for a lot of bad publicity. On the other hand, the Model Garage, coming to the rescue in Ryberg's absence, stood to gain favorable attention.

Walt Sommers smiled as Gus approached with his tool kit. "Here comes the fellow I wanted you to give your work to, Stafford. Gus, this is Oliver Stafford, one of our newcomers."

"Glad to meet you, Stafford," Gus said as he put down his kit. "Walt phoned me that you were having trouble."

"That's right." Stafford's eyes held a glint of exasperation. "I had Ryberg do a complete overhaul—valves, rings, bearings, everything. And now, in less than

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a hundred miles, my motor gets hot and sticks. The starter won't budge it."

"You say that the motor got hot?" Gus asked.

"Yes. I noticed that the heat gauge was in the red when I parked, but I sort of expected this with a tight motor. But I didn't expect the engine to be stuck tight when I came out from shopping."

"Maybe it isn't," Gus said. "Perhaps the starter gear is locked in the flywheel ring gear. I'll take a look."

Gus pulled the starter and found it free. With the ring-gear teeth exposed, he tried to turn the motor by prying against the teeth with a bar. But the motor was, indeed, so tight that it was impossible to budge it. As he straightened from replacing the starter, he found himself ringed by curious shoppers.

He smiled to himself when he heard one of them say, "So that's Gus Wilson, eh? I've heard he's a whiz."

Gus turned to Stafford. "You say the heat gauge was in the red when you parked? Modern engines don't usually heat up that much on an overhaul."

Walt Sommers spoke up loudly: "It depends who has worked on them. If you don't know your business, anything can happen."

GUS raised the hood, removed the radiator cap, peered inside.

"Hmm," he grunted. "Water's awfully low."

He got down on his knees, peering under the car, looking for leaks. Seeing none, he began to remove the spark plugs. Nothing happened—until he removed the third plug on the six-cylinder head. As he took out this plug, water spouted high as though under pressure.

"She'll turn over now," Gus said, wiping moisture from his leathery features. "You must have a leaky head gasket."

"Leaky head gasket!" Stafford exclaimed. "But how would that make the motor stick so it wouldn't turn over?"

"When you parked your car," Gus explained, "number three cylinder was about to come up on the compression stroke. It filled with water, probably from a leaky head gasket, while you were in shopping. When you tried to start the car, the piston moved up against the water. With a well-fitted set of rings and a perfect valve grind, so that the water couldn't escape, it would act about the same as a cylinder full of cement. Ryberg must have done a good job on those rings and valves."

Stafford grunted. "And how about the water in my cylinder?"

"It sounds like a faulty head gasket," Gus repeated.

"Yeah," Walt Sommers commented. "Maybe Ryberg just forgot to tighten the head bolts."

As Gus turned, planning to fetch his tow car and take the car into the shop, his eyes met the interested and curious gaze of the ring of spectators, mostly new faces to the area. He hesitated, then stooped to pick up his long-handled torque wrench.

"It's possible," he said thoughtfully. "Let's see."

He began to run the torque wrench over the head bolts, testing them for tightness. The center bolt of the middle row turned easily under his hand and lifted. Gus took it out. It was broken off.

"Hah," Walt Sommers said. "Some of these young, inexperienced bucks don't know their strength. Ryberg twisted that head bolt right off."

"Maybe, but not probable," Gus said, taking his flashlight and peering down in the hole the broken bolt had come from. "The stub end of this bolt shows a rust streak through the metal that indicates a flaw. I'd better tow you in to the shop, Stafford."

IN THE Model Garage, Gus faced the tricky job of removing the broken stub of the bolt from the cylinder block.

"How on earth will you get that out?" Stafford wanted to know.

"The usual way," Gus told him, "is to drill a hole through it and then screw in a reverse-threaded tool made of steel hard enough to cut into the broken stub and remove it. The only trouble with that method is that if you drill too large a hole in the broken end of the bolt, the tool will bulge the skeleton of the bolt and lock it in the cylinder-head threads. If you drill too small a hole you have to use too small a reverse-threaded tool to stand the strain of taking out a rusted-in head bolt. If you break the tool off you're really in a jam, since it is made of steel too hard to be drilled."

"Then how do you get it out?" Stafford

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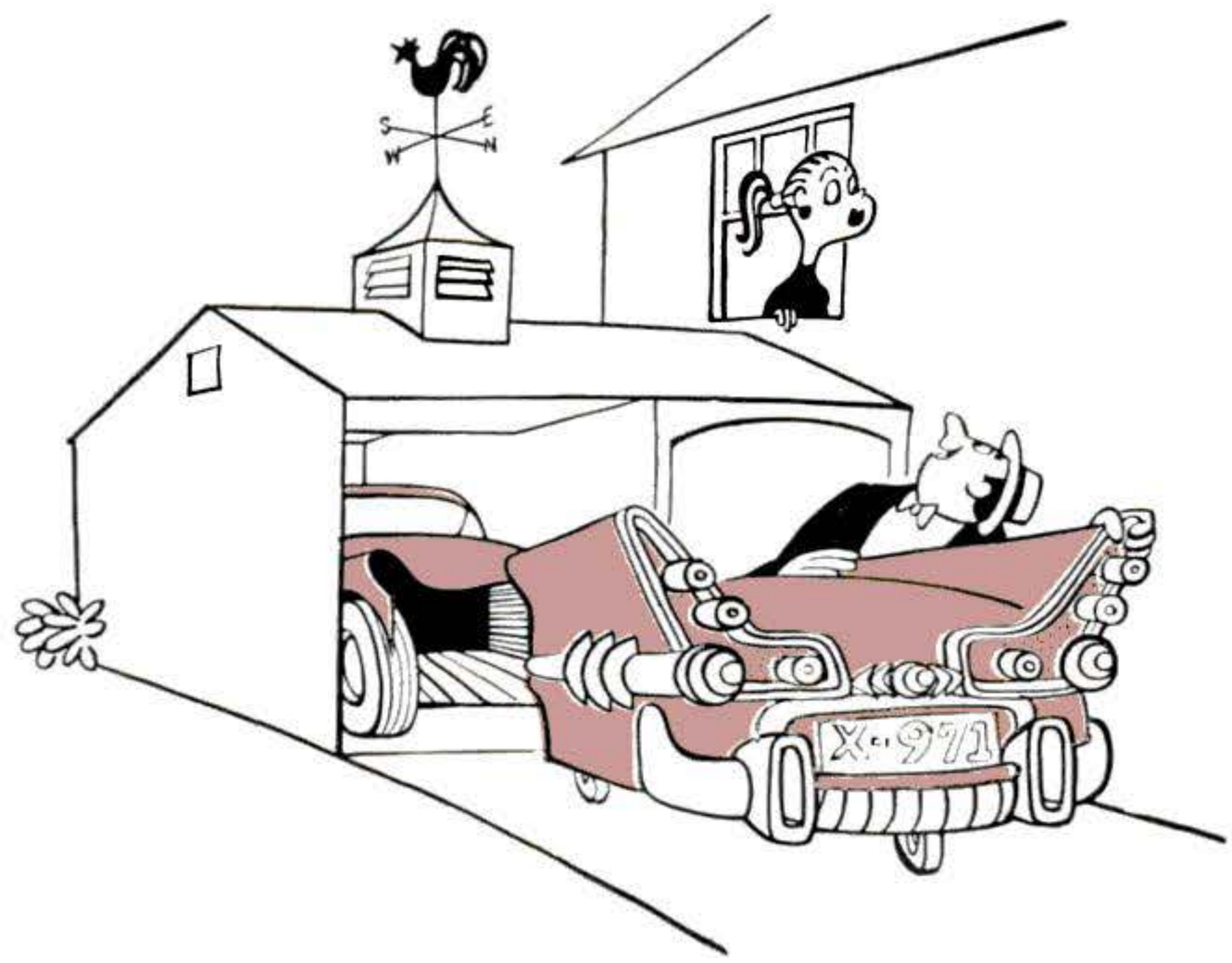
asked. "It seems like an impossible job."

Gus grinned.

"If a man's hand is steady enough," he said, "he drills a perfectly aligned hole down through the broken bolt end, just a hair smaller than the bolt. The remaining portion of the bolt is then so thin-walled that you can break it away from the cylinder-head threads with a fine chisel. Then you can take it out with the end of a rat-tailed file."

"You sure know your business, Wilson," Stafford said as he watched Gus delicately remove the broken stud bolt from the cylinder head. "Walt Sommers warned me that Johnny-come-latelies are dangerous, in plumbing or in auto repair. I should have given you my work."

"I'd have been happy to have it," Gus said. "But it seems to me that Ryberg did a good job. My torque wrench showed that the rest of the head studs were tightened to 60 foot-pounds, as the factory specifications for this car recommend. Ryberg would hardly bear down on this one bolt and break it off. Since we know from the rust streak through the metal at the break that there was a flaw in that stud, which Ryberg couldn't have known about or prevented, I hardly see where he can be blamed."



"This 'bustle' rear is removable so we can close our garage door."

Stafford spoke thoughtfully: "It seems to me that you are either a very square guy, Wilson, or you don't want any more business."

"I want all the business I can get," Gus told him, "but not by digging at a competitor's reputation. I wouldn't know Paul Ryberg if I met him face to face, but I do know the bad publicity a thing like this could bring him in a new community. It could put him out of business."

Stafford countered, "And give you more business."

"Probably," Gus said. "For a while. But this area is growing so fast that we need all the skilled help we can get. Folks expect services when they move to a new place, and if they don't get them that place stops growing. In the long run, putting the skids under a fellow like Ryberg would cause me and everyone else in the community to lose. The way I see it, his coming here is progress."

"I guess it is, at that," Stafford conceded. "If folks who move here don't get the services, they'll stop coming. Maybe Sommers didn't think of that. By the way, I hear Paul Ryberg's brother is coming, too, to open a shop in town."

"You don't say," Gus said. "Do you know what line he's in?"

"Yes, let's see—Ryberg told me." Stafford's eyes suddenly widened as they met Gus's. "Come to think of it—his brother is a plumber."

"I see," Gus said, and he did see very clearly.

He drained Stafford's car of oil, to make sure there was no water in the oil pan, and set about installing a new head-bolt stud and gasket.

As he worked, his mind drifted to Walt Sommers. Some folks, he thought, are scared of progress when it starts getting close. END

Next Month: Gus does it by the numbers.

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Transistors power Servo-System Hi-Fi

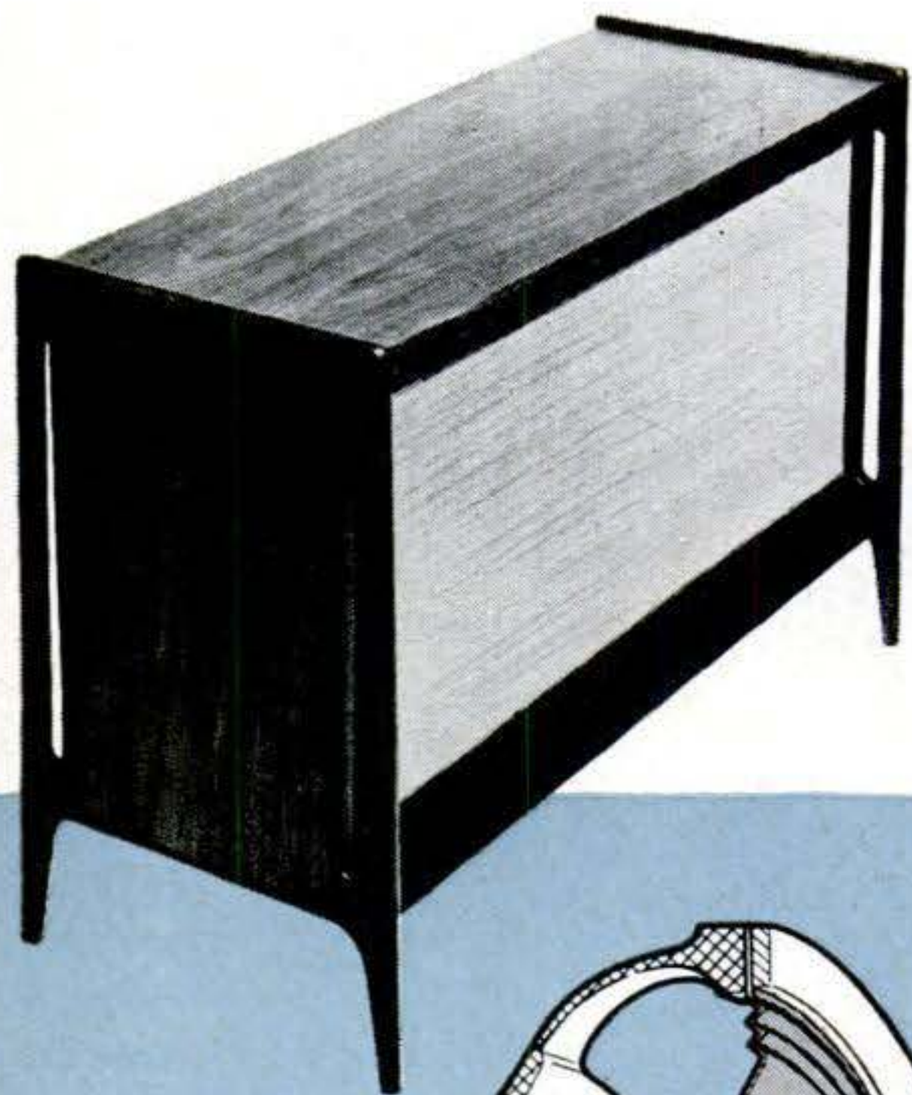
A FACTORY-SEALED timer backs up a guarantee of 2,000 hours of satisfactory performance for a new hi-fi speaker-amplifier unit. That's about five years of normal operation. The timer operates only when the unit operates and will show at any time whether the guarantee has been met.

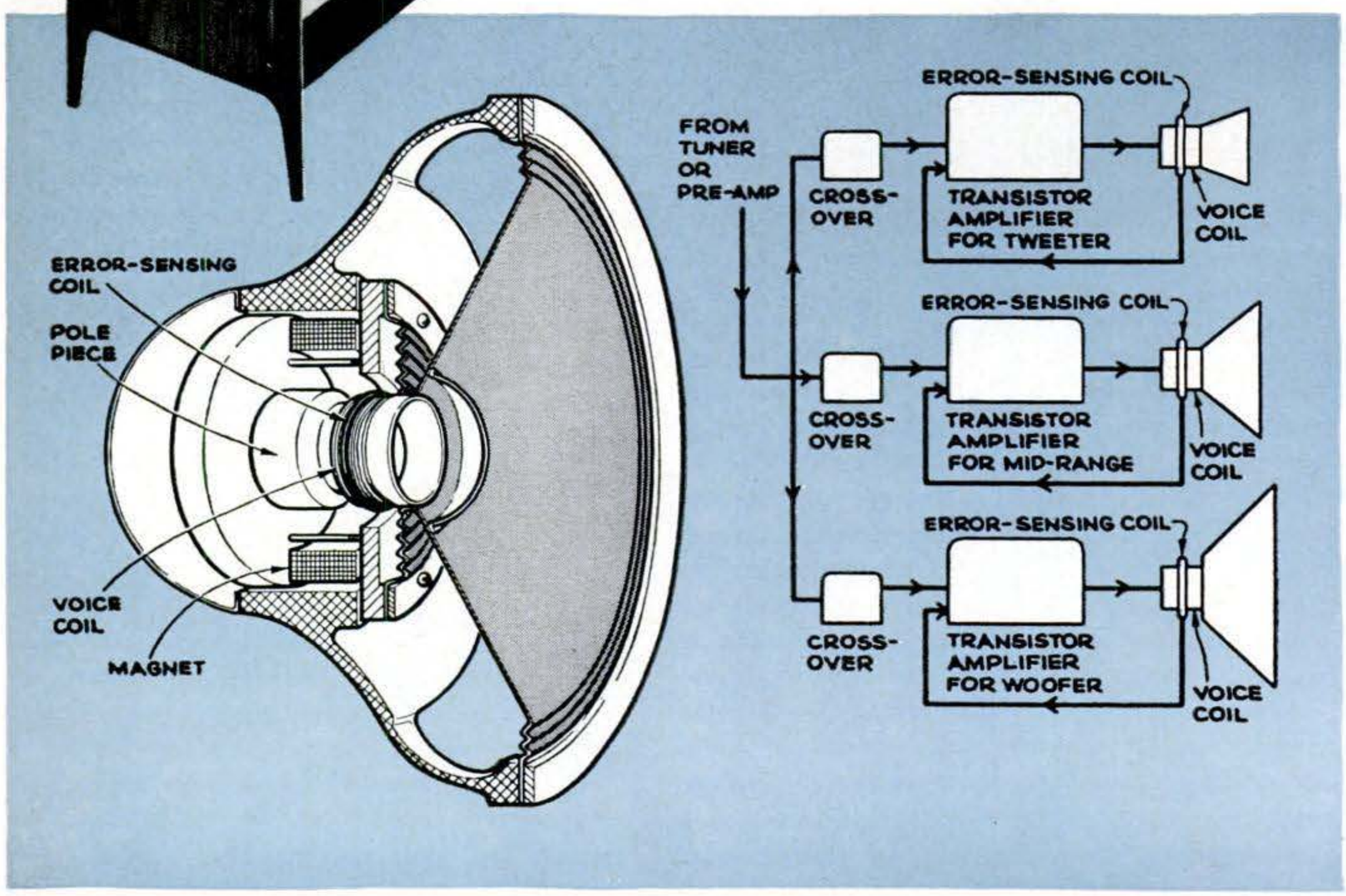
Performance specs are impressive, too. The maker guarantees response within three decibels from 35 to 16,000 cycles at less than one-percent distortion for one acoustical watt output (about 20 electrical watts).

This new integrated sound-reproduction unit incorporates an unusual concept. It combines the functions of amplifier, loudspeaker and enclosure in one electro-acoustic network.

Transistors and a new speaker have made a commercial reality of a system long considered theoretically desirable by engineers. Theory: If you can get exact information about the sound being produced by a loudspeaker, this signal can be fed back to the input of the driving amplifier and compared to the original signal. Any differences in the two signals would be due to error on the part of the amplifier or loudspeaker. This error signal can then be incorporated in the incoming signal in such a way that any shortcomings are continuously compensated.

The Integrand system does just this. Three different speakers cover the audible range. Each speaker has an error-sensing coil, mounted in the center of the voice coil, that feeds back information to its own transistor amplifier. Both monaural and stereo Integrand units are marketed by Brand Products, Inc., Westbury, N.Y. Prices start at $395.





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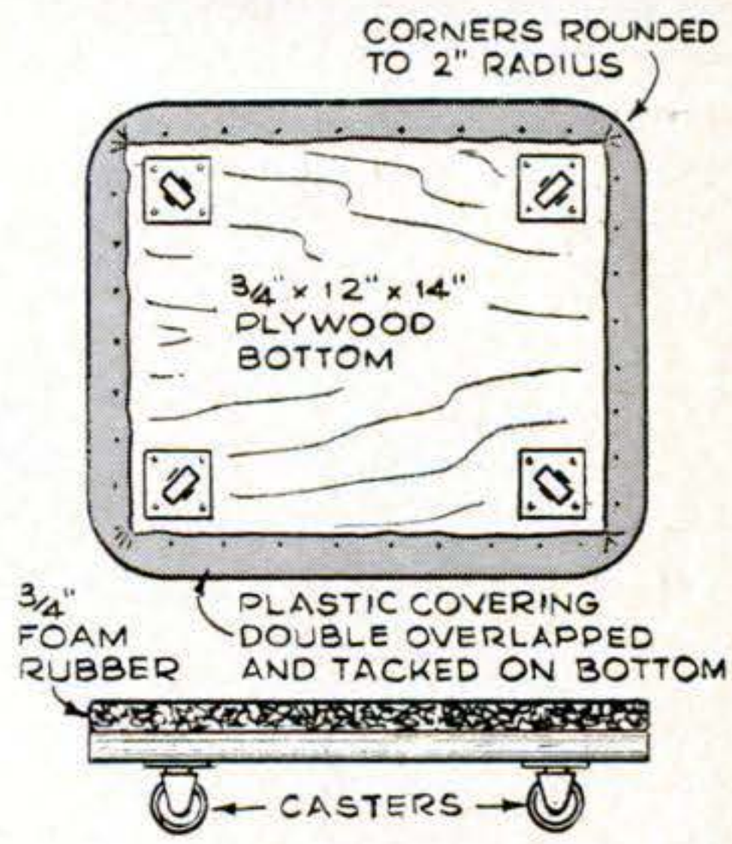
Short Cuts and Tips

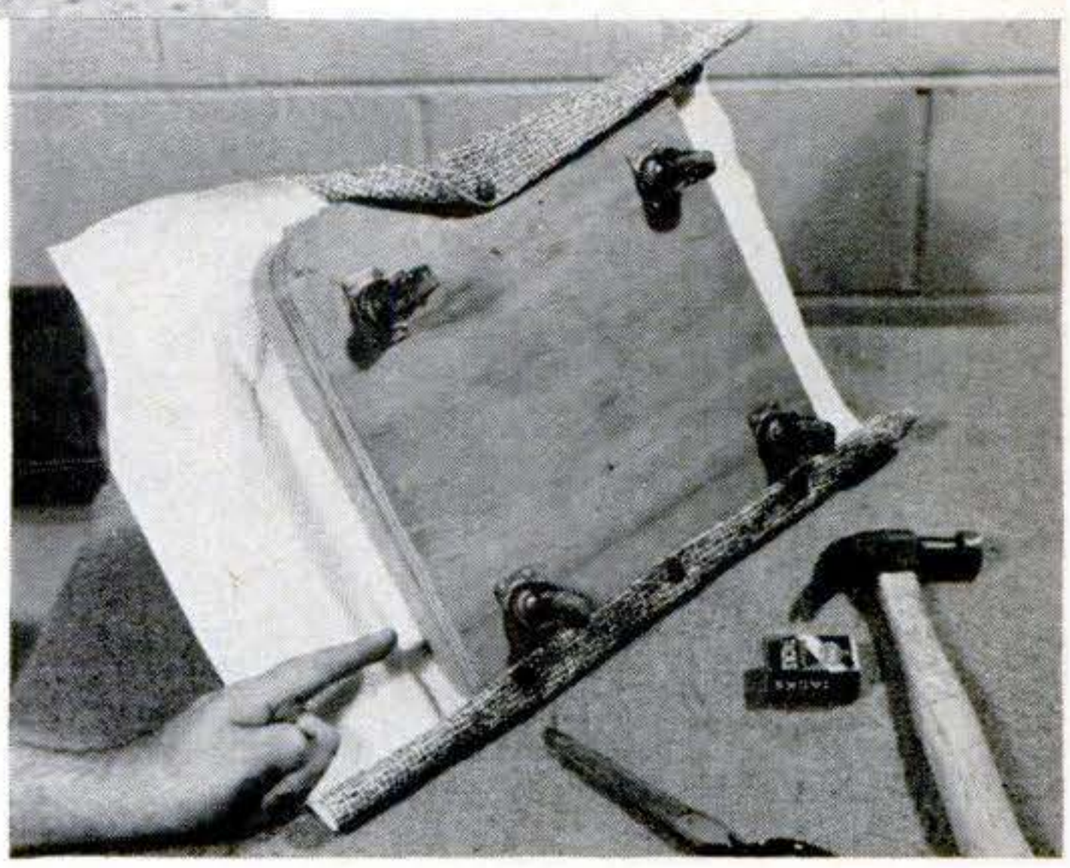
FROM PS READERS



Knee Pad Can Roll Around Floor

MY WIFE gives the kitchen floor a thorough scrubbing in relative comfort by kneeling on the cushioned dolly I made. We move heavy objects with it, too.

I glued a foam-rubber pad to a 12″-by-14″ platform of ¾″ plywood. The platform's corners were rounded to a 2″ radius. Over the trimmed rubber pad I stretched plastic upholstery material and doubled the edges before tacking them down. Four swiveling casters went on the bottom.—*Ronald Anderson, Minneapolis.*



Could You Use This Idea?

TOO much noise from a workshop or recreation room? You can muffle the sound effectively with perforated hardboard panels backed by glass-fiber insulation blankets.

Laboratory tests made for the Masonite Corporation indicate that these two common materials provide a satisfactory measure of noise reduction compared with common acoustical material. The panels used were ⅛″ Peg-Board with $\frac{3}{16}$″ holes spaced on ½″ centers. The glass-fiber blankets can be placed between furring or wall studs and the hardboard panels nailed over them. Painting the panels doesn't affect sound-deadening ability, it is claimed.

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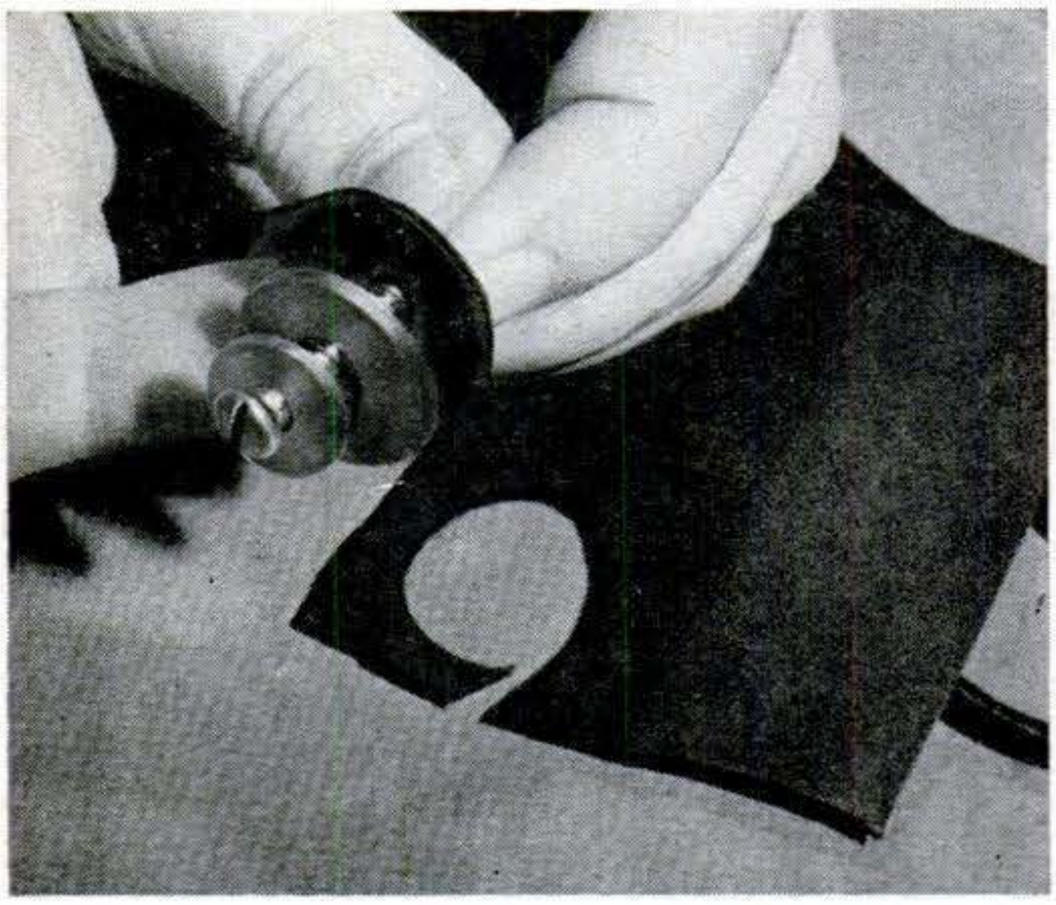
Short Cuts and Tips

Heavy Roofing Rolls on Skates

HANDLING heavy papers and roofing felt is a lot easier when the roll is cradled by a pair of roller skates. I nail the skates upside down to a board, adjusting the distance between them to balance the roll.—*John Fields, Chesterfield, Ind.*

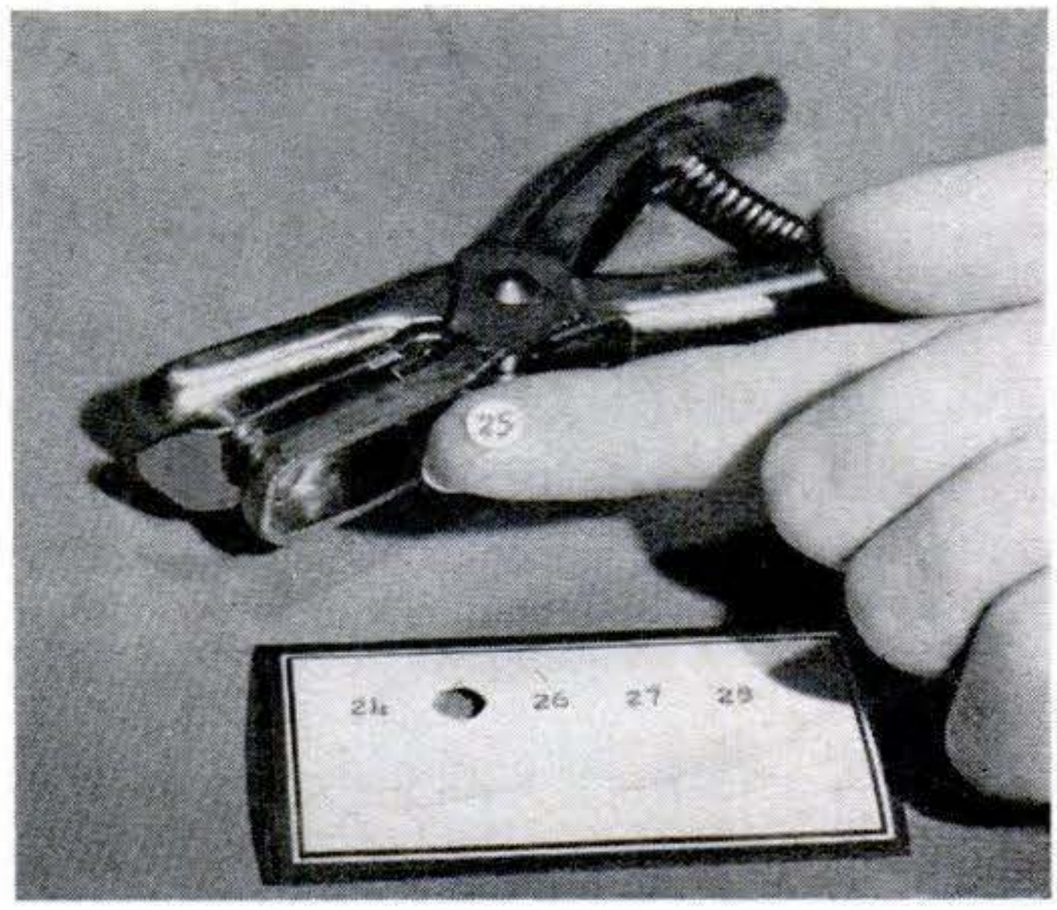
▶▶▶HERE'S a way to speed up frequent shifts of garden hose from one faucet or sprinkler to another. Put several extra washers in each coupling as spacers. Doing that leaves less thread to be engaged. —*John Cavanaugh, Monterey, Calif.*

▶▶▶I FOUND that the carburetor cleaner used in garages will dissolve India ink quickly and completely. To keep drawing pens clean without scraping them, I dip the points in cleaner and wipe them dry with a cloth.—*John Nestler, Tampa, Fla.*



Simple Plug Repairs Leaky Tank

SMALL leaks in metal containers, such as water tanks, are easy to repair. Slip a couple of washers over a sheet-metal screw and add a large rubber disk cut from a scrap of inner tubing. Screw the plug in tight. The pressure of metal washers on the rubber will insure a permanent seal.—*Frank Javor, Newark, N.J.*



Punch Turns Out Index Tabs

THESE index tabs are economical to make and they stick to anything. I type numbers on gummed paper, such as a label, and cut them out with a large paper punch. For contrast or special keying, I use colored paper. The tabs are handy whenever I want to sort or file something in a hurry.—*Fred Jenkins, Deal, N. J.*

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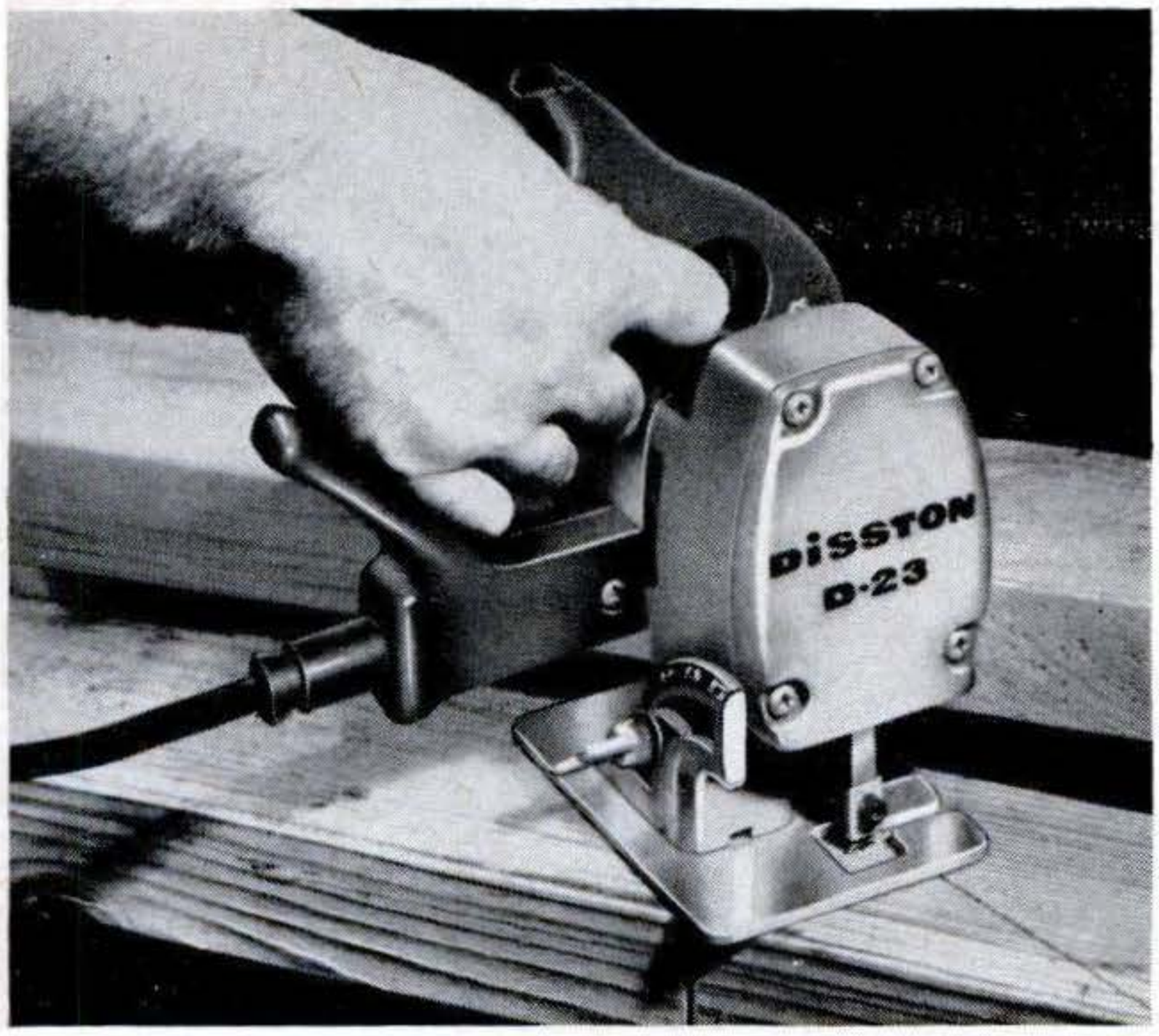
Zips through 2 x 4's . . . cuts ¼″ steel plate . . . cuts ½″ aluminum plate



Plunge cuts without a drilled hole!

Cuts through hardwood 2 x 4's at 45° angle!

Cuts intricate figures in all materials!

Detachable electric cords come in lengths up to 100 ft.!

NOW! THE WORLD'S MOST USABLE POWER SAW!

The revolutionary DISSTON D-23 Electric Handsaw!

This brand-new multi-purpose power saw answers the crying need of home workshop owners everywhere. It gives you—in a single professional tool—a whole shopful of power saws. Weighing only 4½ pounds, *it does more cutting jobs than any other saw of its kind.* Rips, crosscuts, mitres, bevels, scrolls. Does heavy workhorse cutting or fancy figures with equal ease and precision.

The Disston D-23 Electric Handsaw cuts every common home workshop material. It cuts wood, plywood, plastics, rubber tile, linoleum tile, asphalt tile, laminated paper and cloth, nylon and Plexiglass. It cuts ¼″ steel plate, ½″ aluminum plate, angle iron, copper, bronze and brass. It cuts pipe, tubing and sheets.

Features unmatched by other saws have been engineered into the Disston D-23 Electric Handsaw to make it the world's *finest*—as well as the world's most *usable* power saw. First, it gives you more *cutting power* than any other saw because it has the highest output horsepower. A 3-amp motor drives it at 3800 strokes per minute. Second, it cuts *faster* than any other saw because of remarkable ORBITE action. The blade slices through material on the upstroke, but backs away on the downstroke. This also reduces fraying, need for sanding, and blade wear. Third, the new Disston D-23 Electric Handsaw *cuts more accurately* and *lasts longer*. It is the *only* reciprocating saw with all needle and ball bearings—9 needle and 3 ball bearings. Check these features against *any* saw now on the market.

Your most economical buy in power saws. Think of the 1,000-odd uses you have—right now—for this power-packed lightweight! In home repairs and improvements you'll be able to make. In do-it-yourself projects. Think of the times you've wished for just one additional saw for a particular job at hand. Think of the times you've said to yourself that one day you'll have *all* the saws you need. *You can have them all* right now in this built-to-last, most usable power saw ever made. With four blades, rip fence and 10-foot detachable cord, the revolutionary Disston D-23 Electric Handsaw sells for just $98.50.

FREE! "Must" reading for every man interested in fine tools—Disston Workshop Manual No. 1. Read it before you buy *any* saw!

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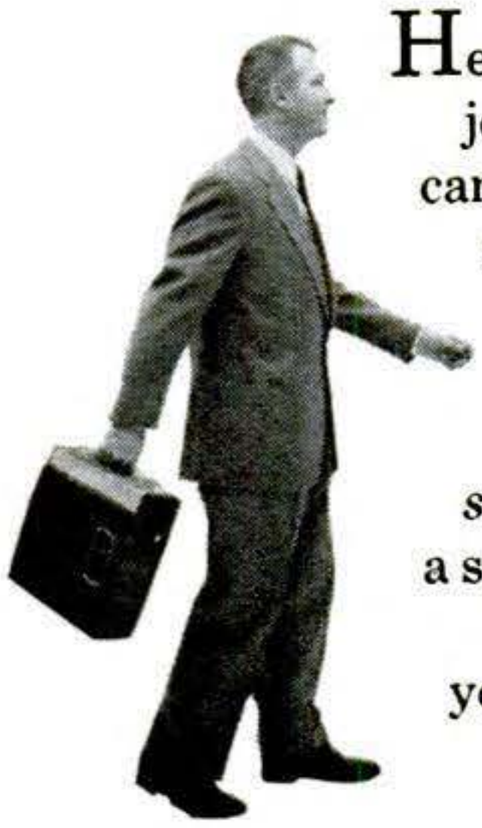
New Kodak 300 Projector

yet shows your slides bigger,



Here's a color-slide projector so lightweight you can carry it like a portable radio . . . so compact, you can store it on a bookshelf. Best of all, it lets you enjoy thrilling *big-screen* projection even in a small room. At a distance of 10 feet, for example, your favorite 35mm color slide will fill a 40-inch-wide screen.

You really have to see and handle the new Kodak 300 Projector to appreciate its remarkable versatility. Try the focusing and elevating mechanism . . . the smooth glide of the new Kodak Readymatic Slide Changer. And when you project your favorite color slide, notice that the rock-steady picture you get is brilliantly illuminated *clear to the corners!*

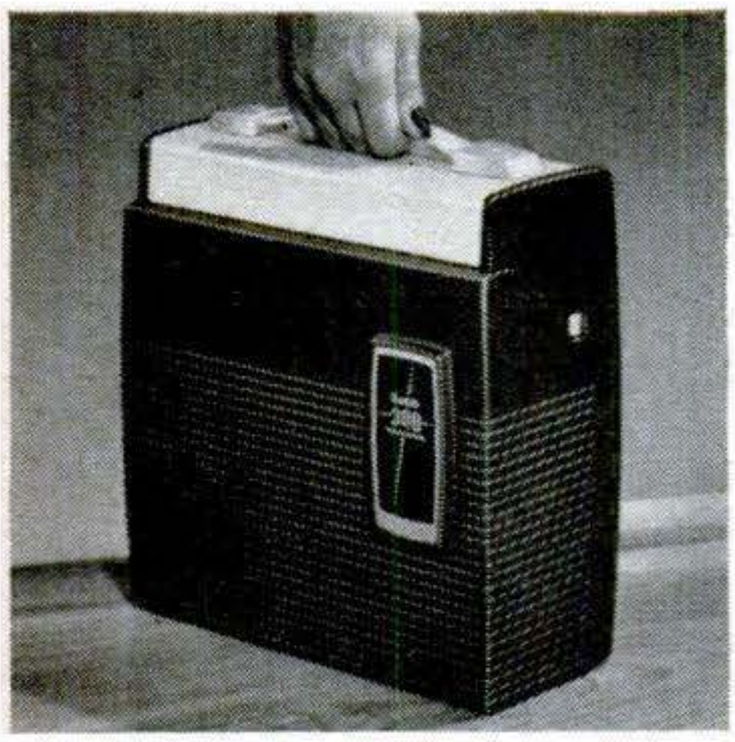
Your Kodak dealer will be glad to show you the new lamp-condenser system and superb 4-inch, *f*/3.5 lens that produce these superior screen results. Ask him, too, about the Kodak 300 Projector's ultra-quiet cooling system . . . built-in cord storage space. Complete with self-cover.

Kodak 300 Projector with Readymatic Slide Changer (holds up to 36 slides in cardboard mounts), $64.50 . . . or as little as $6.45 down.

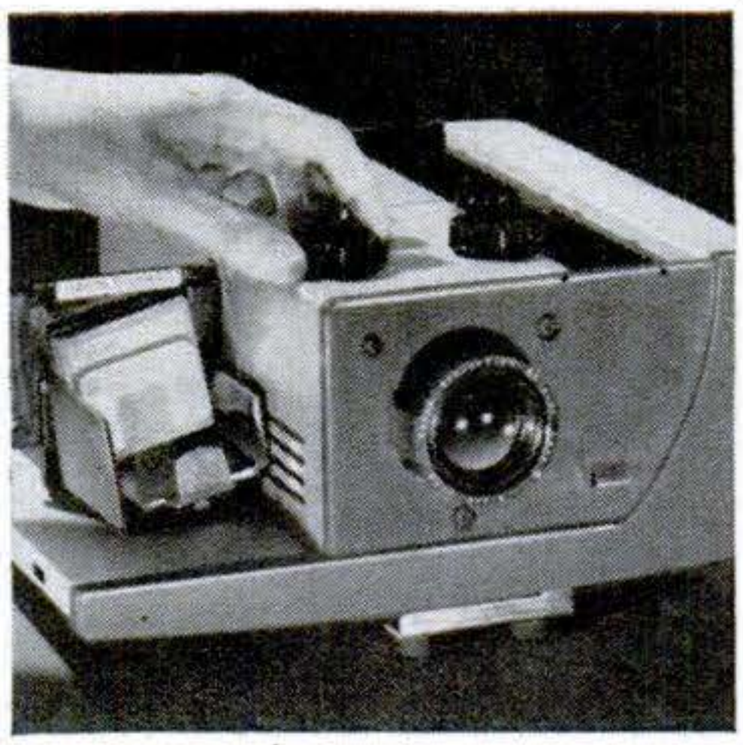
Kodak 300 Projector with 36-slide self-storing Magazine Changer, $74.50 . . . as little as $7.45 down.

Prices are list, include Federal Tax, and are subject to change without notice.

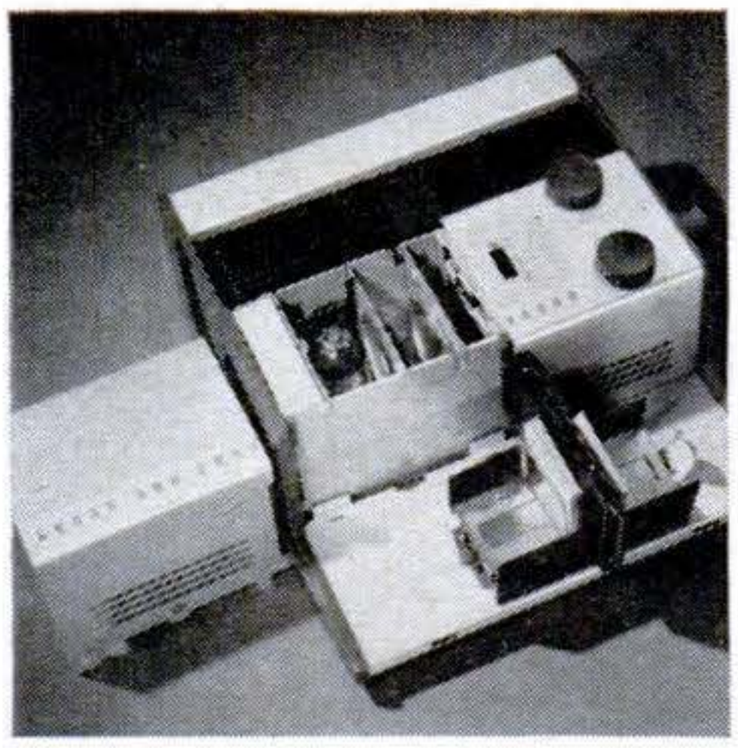
The only projector with the completely new



SO LIGHT, SO COMPACT, so easy to carry! Has self-cover, measures only 5 x 11 inches square, weighs only 9 pounds.



FOCUSING AND ELEVATION adjustments are fast . . . precise . . . with all essential control knobs at your finger tips.



QUICK, E-A-S-Y ACCESS to the lamp and condenser compartment—storage space for your lamp cord is built right in.

EASTMAN KODAK COMPANY,

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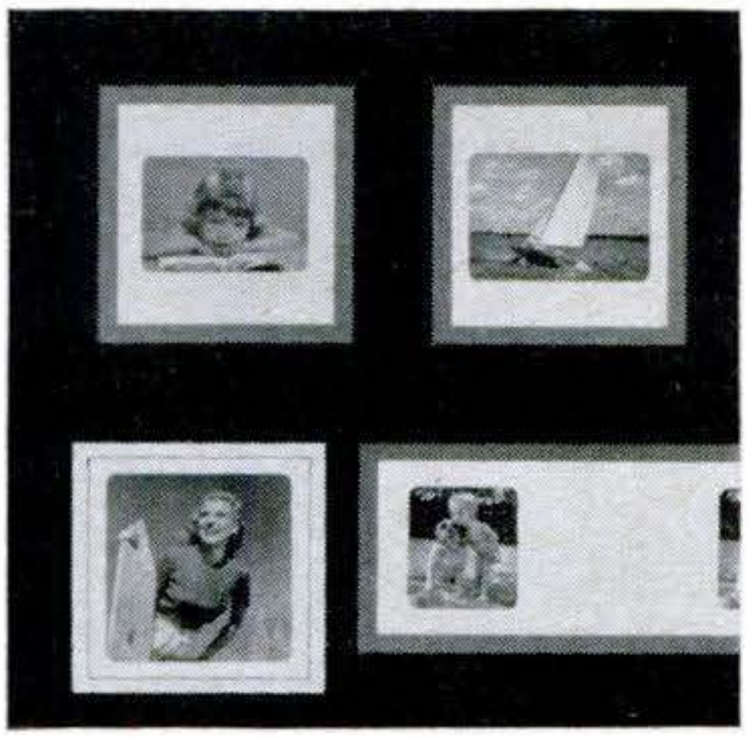
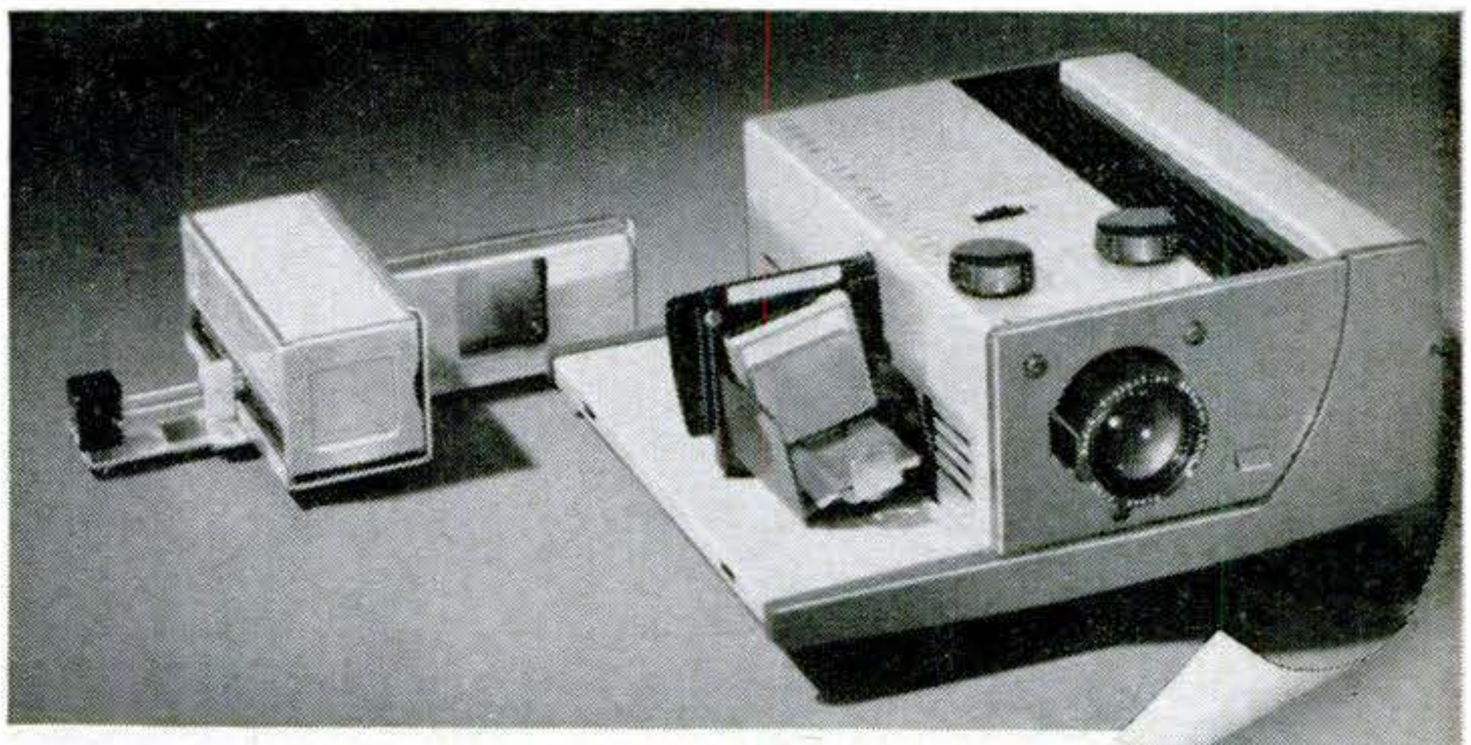
is ultra-portable

brighter!

Kodak **READYMATIC SLIDE CHANGER**



PROJECTS 35MM, BANTAM, or the new, big 1½ x 1½ slides. Also (with an adaptor) single frames of your stereo slides.



CHOICE OF EXCLUSIVE new Kodak Readymatic Slide Changer which accepts up to 36 slides per loading, or self-storing, magazine-type slide changer.

Rochester 4, N.Y.

Kodak
TRADE-MARK

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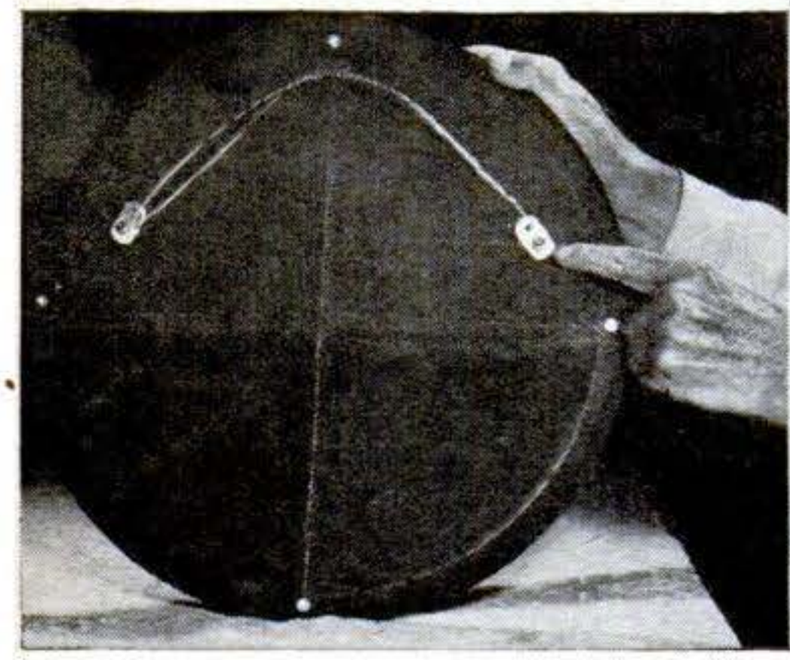
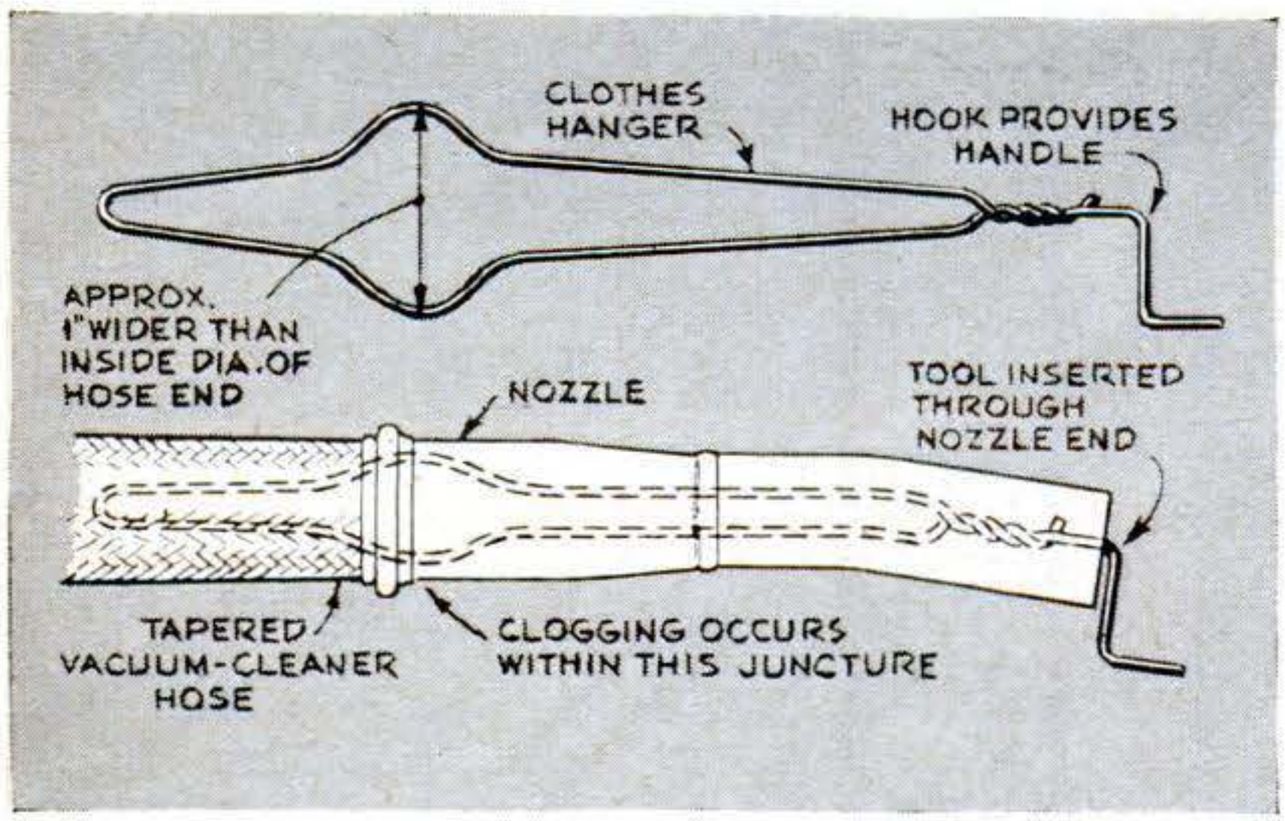
Short Cuts and Tips



Easy-to-Mount Mirror Backing Makes Handsome Frame

DECORATIVE, prefinished hardboard can make any mirror as pretty as a picture. For this round one, the outline was traced on the back of black-and-gold marble Marlite. Then, with the finished side up, an outsize circle was cut with a fine-tooth handsaw, and bolt holes drilled for brackets and hanger clips.



Bent Wire Hanger Cleans Vacuum Hose

WHEN a tapered vacuum-cleaner hose clogs, the trouble spot is usually where hose and nozzle join. A wire coat hanger, bent as shown, will clear it. Push the tool into the nozzle until the loop-spring is forced against the walls of the juncture. A few turns of the handle will then loosen the debris that is causing the jam.—*Bruce D. Stewart, Winder, Ga.*

COMING SOON:

Two Bonus Booklets on House Painting

In March PS: *You'll want to read and save this bonus booklet: "Things to Do Before You Paint Your House." It's packed with tips on old-paint removal, calking and puttying, minor repairs, and estimating paint quantities. It gives you a time-saving shopping list, and sound advice for choosing the right paints, brushes and rollers.*

In April PS: *When you're ready to take brush in hand, a second booklet, "The Know-How You Need When You Paint Your House," will see you through the actual job of brushing new beauty onto your home. It tells you every trick of the trade, from the right sequence to follow when you paint window sash to cleaning brushes the easy way.*

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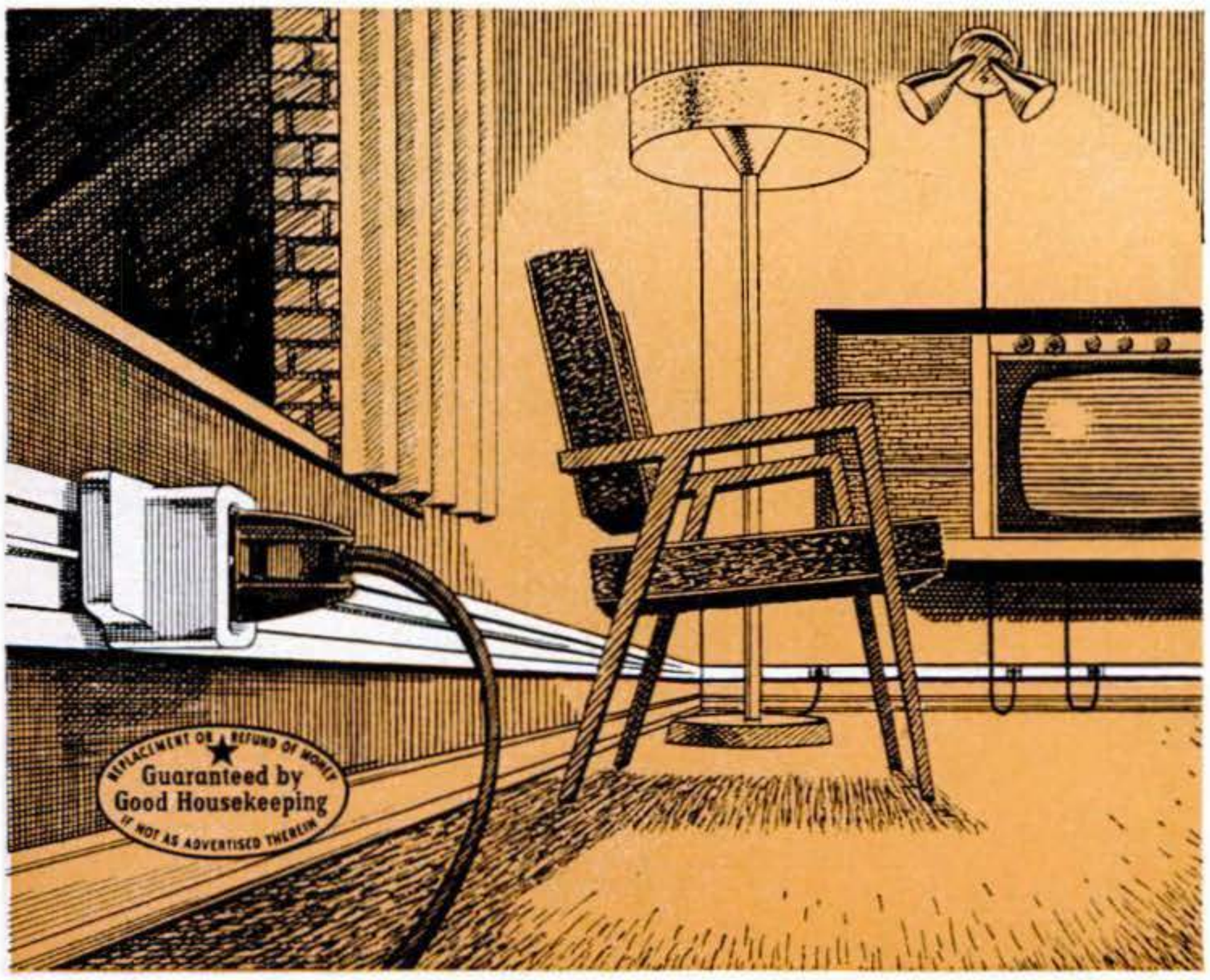
5 EASY STEPS TO UNLIMITED ELECTRICAL OUTLETS



Electrostrip

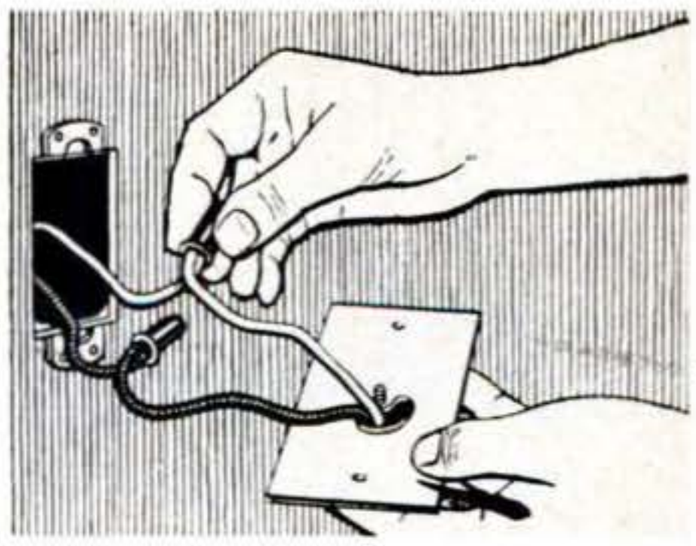
PATENTED ®

Have all the electrical outlets you need with Electrostrip. Now in a new "do-it-yourself" kit, this modern home electrical system lets you twist in outlets any place along the strip . . . plug in lamps, appliances, TV exactly where you want them. Enjoy the extra convenience Electrostrip brings to every room in your home . . . install it yourself.

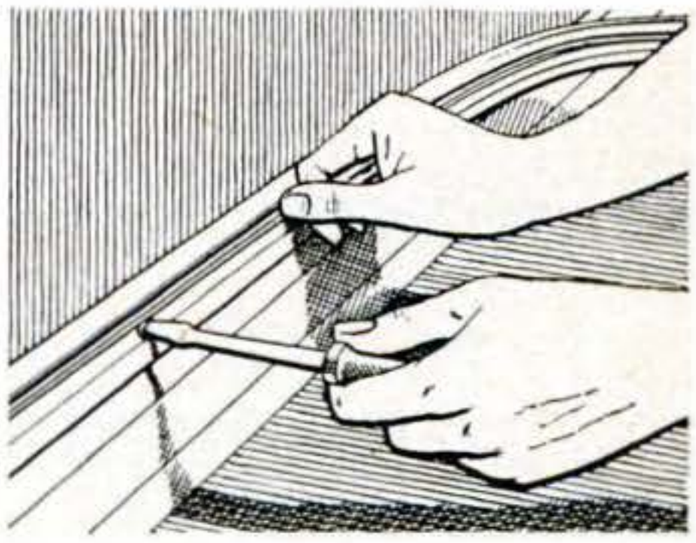
Electrostrip attaches to existing outlets quickly and easily. It mounts on walls, moldings, anywhere . . . can be painted to match any color scheme. And it's listed by Underwriters' Laboratories. Get Electrostrip from your hardware or building supply store. BullDog Electric Products Co., Box 177, Detroit 32, Michigan. In Canada. Toronto 15. © BEPCO

Look for the colorful kit: 15 feet of strip, 4 outlets and fittings with detailed and easy-to-follow installation instructions —all for only $9.95. You'll enjoy full HOUSEPOWER with Electrostrip.

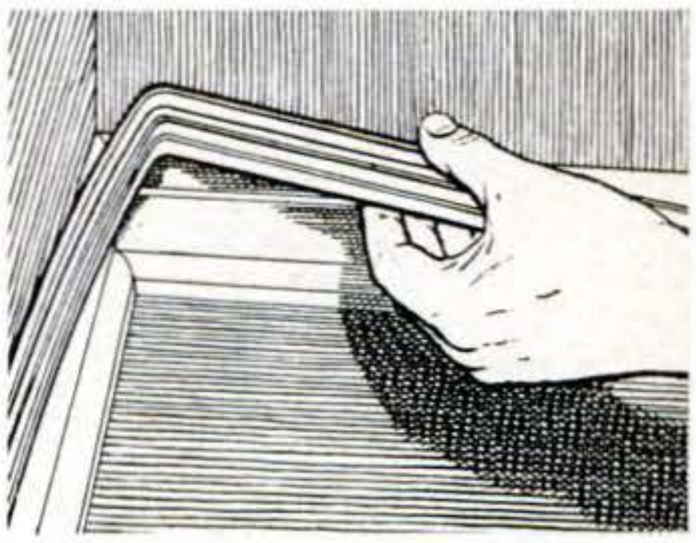
Made by BullDog Electric Products Co., a division of I-T-E Circuit Breaker Co.



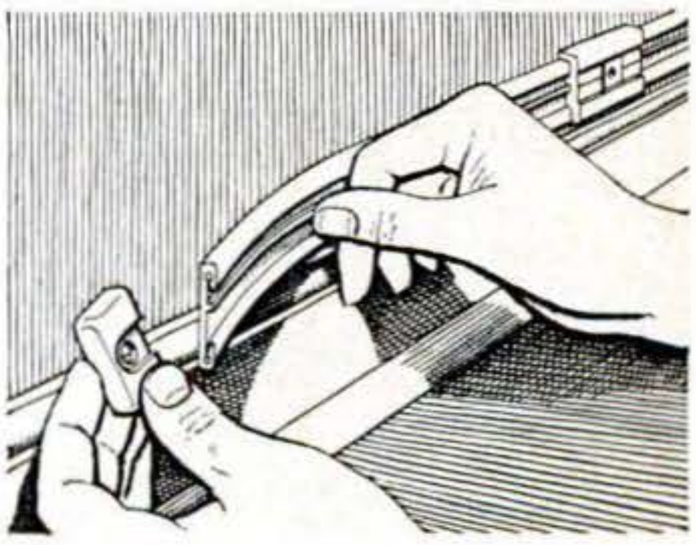
1 Make connection



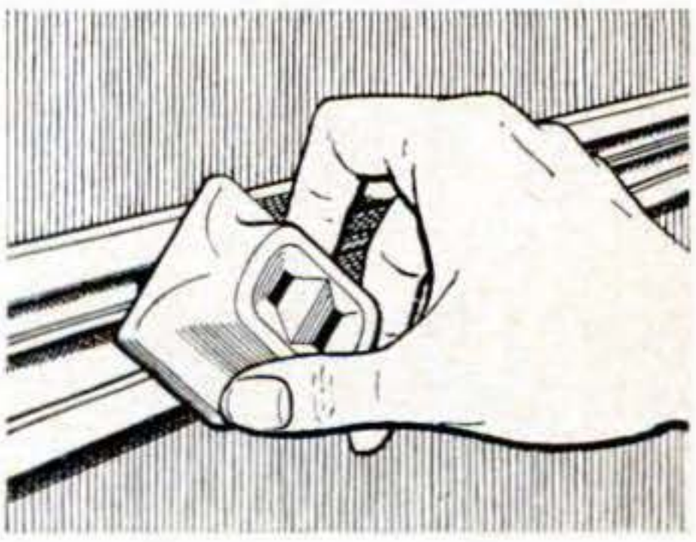
2 Mount Electrostrip



3 Bend at corners



4 Affix end caps



5 Twist in outlets

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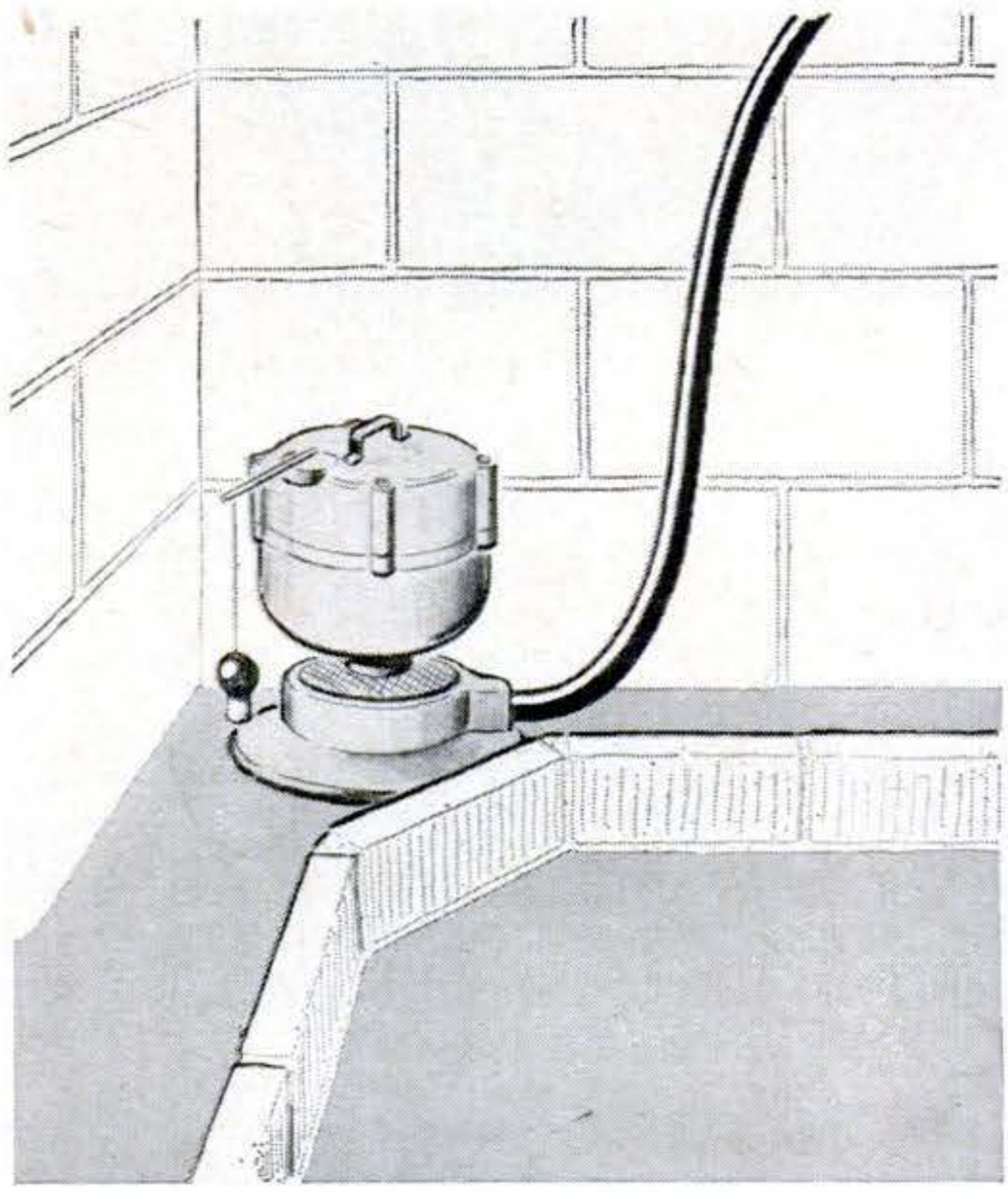
Old Battery Cable Supplies Copper Wire

SALVAGE an old battery cable and you have a good source of copper wire. Cut away the battery-terminal end, strip off the insulation and hang the cable so it will be handy in the shop. Strands can be separated from the cable, unwound and cut to length as needed for lacing or wrapping jobs.—*R. V. Thompson, Clinton, Iowa.*

▶▶▶Screw caps on bottles and cans containing liquids that evaporate readily should be airtight. If the cardboard seal in the cap is lost or damaged, cut a new one from heavy automotive gasket paper.—*Ralph Thomas, Cedar Rapids.*



Brick Dike Channels Seepage

ALTHOUGH I have a sump pump in my cellar, a flat cement floor kept rain and snow seepage from draining off. To remedy the lack of grading, I built a dike that channels wall drippings to the pump. A single row of bricks, it is set back about 4″ from the base of the walls. I used asbestos-fiber roof cement to make a waterproof mortar and, after it set, coated the brick with decorative floor enamel.—*Andrew B. Newman, North Hills, Pa.*

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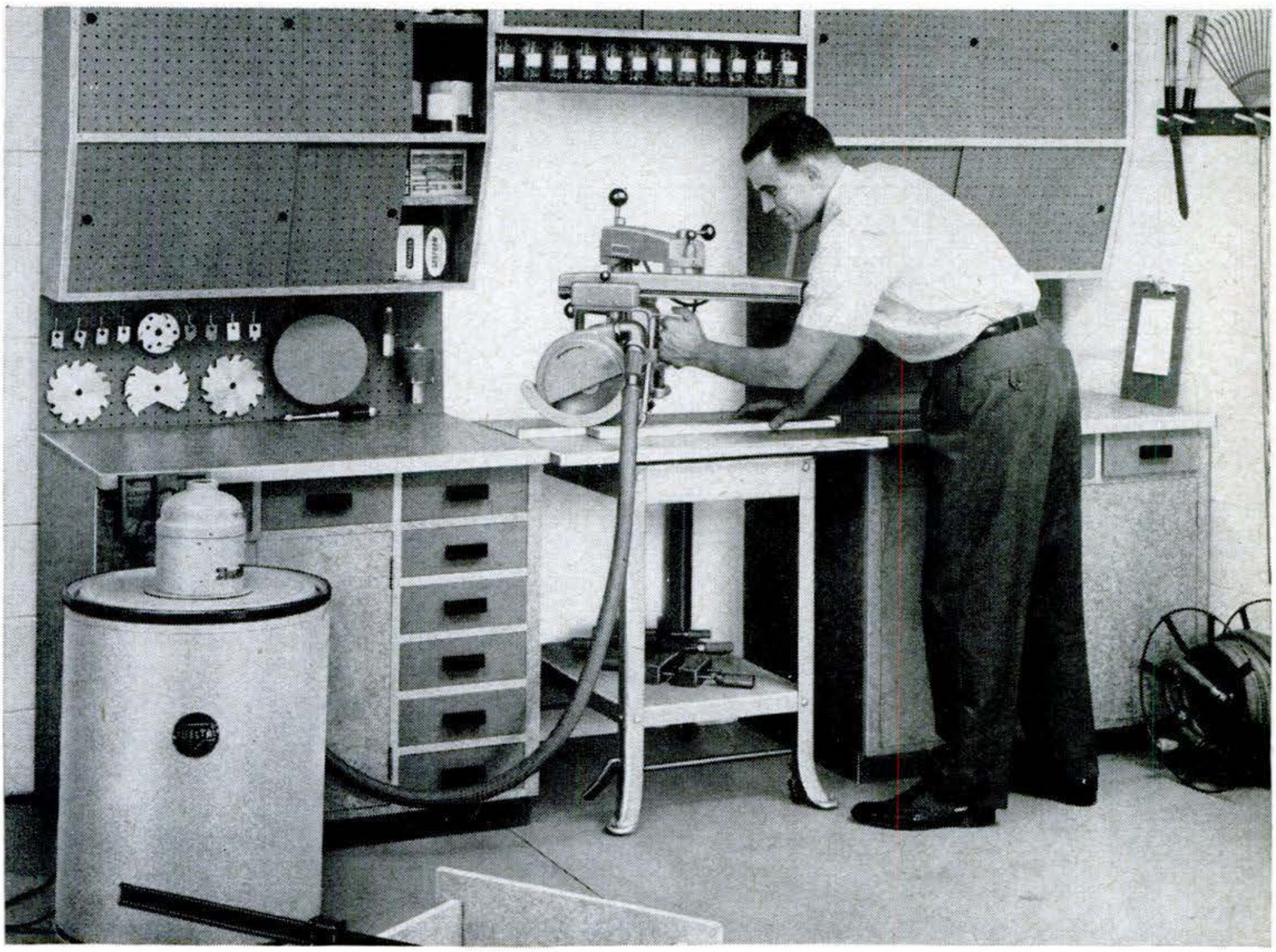
ROCKWELL-BUILT

DELTA "900" RADIAL SAW



most powerful radial saw built for home workshops

Rugged as it is good looking, the New Advanced Design "900" Radial Saw is powered by a *full* ¾ hp motor. And it's so versatile that actually it's a complete, *all-purpose* workshop! You can rip, cross-cut, drill, sand, shape and do many other jobs fast and accurately. Also shown above is the New Advanced Design Delta Dust Collector. Use it with *any* power tool to keep your shop free of sawdust—even to spray paint. It's powerful enough to pick up a 1″ steel ball.

IT'S SO EASY TO OWN THE BEST!

Because Delta makes the world's most *complete* line of combination, all-purpose and individual power tools, you can choose tools exactly right for *you*. And you'll have the "newest look" in the world's finest power tools.

BUILD THIS ALL-PURPOSE SHOP

Delta experts designed the compact workshop shown above so that you can build it in your garage or basement. Easy-to-follow plans and the New Delta Reference Guide are yours—for just 10¢—send your remittance with your name and address to Rockwell Manufacturing Co., Delta Power Tool Division, 504B N. Lexington Ave., Pittsburgh 8, Pa.

Do it now — then see all the New Advanced Design Delta Tools at your Delta Dealer. (He's listed under "TOOLS" in the Yellow Pages.) Or at leading Department, Hardware, and Building Supply Stores.

DELTA POWER TOOLS

another fine product by

ROCKWELL

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??SHOP QUIZ??

Question 1

What's the **EASIEST** way to drive wood screws?

Question 2

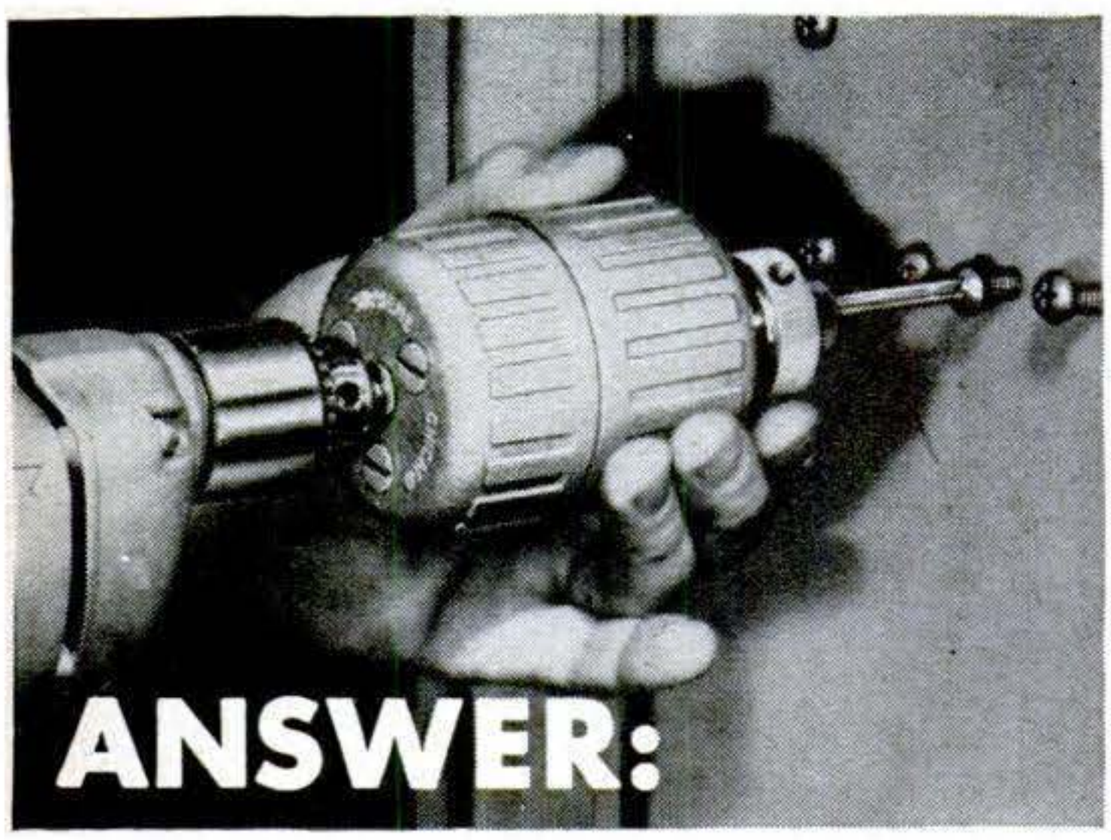
What's the **EASIEST** way to remove wood screws?

Question 3

What's the **EASIEST** way to run nuts or bolts on or off?

Question 4

What's the **EASIEST** way to use heavy-duty cutting tools like hole saws, masonry and auger bits?



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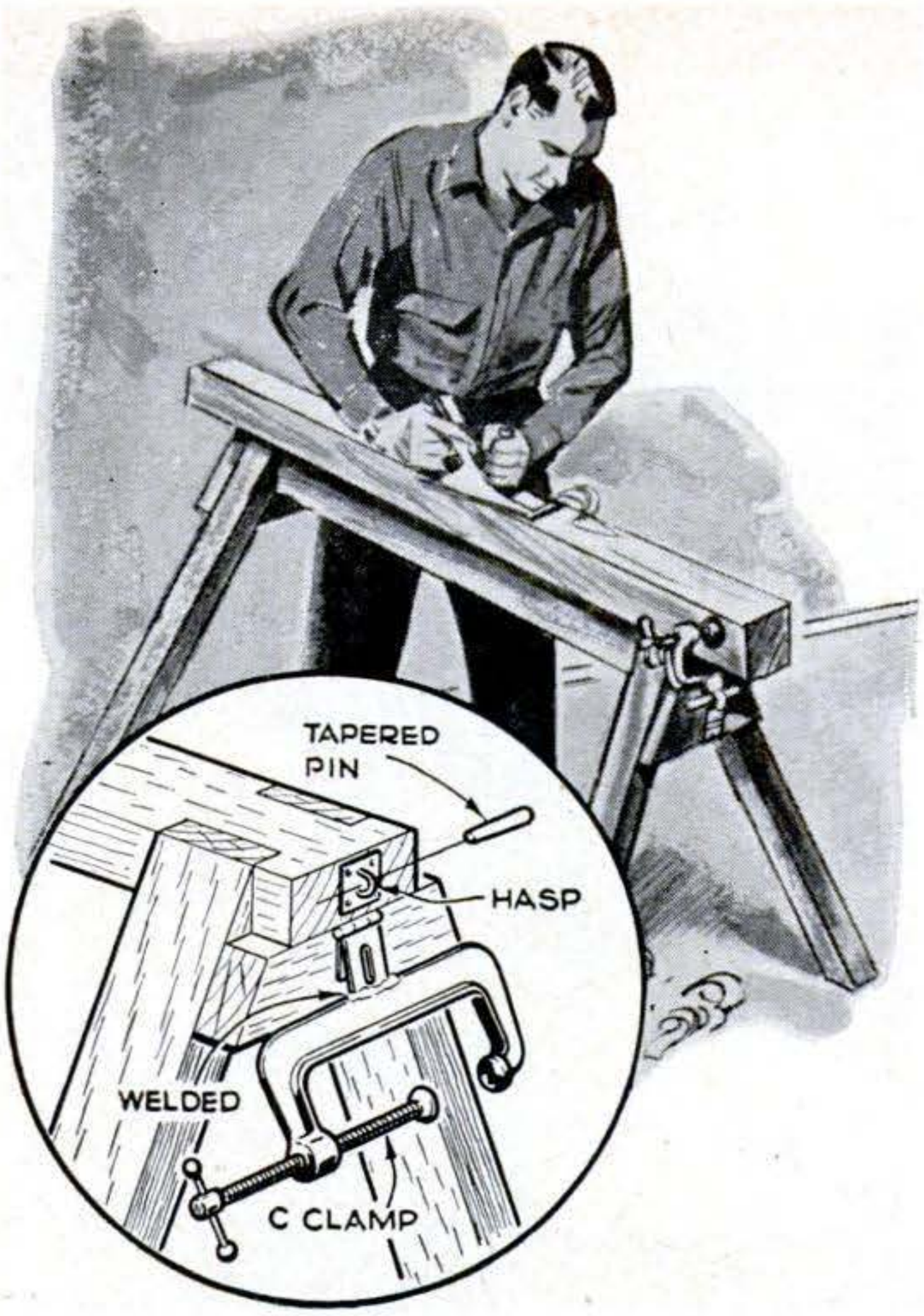
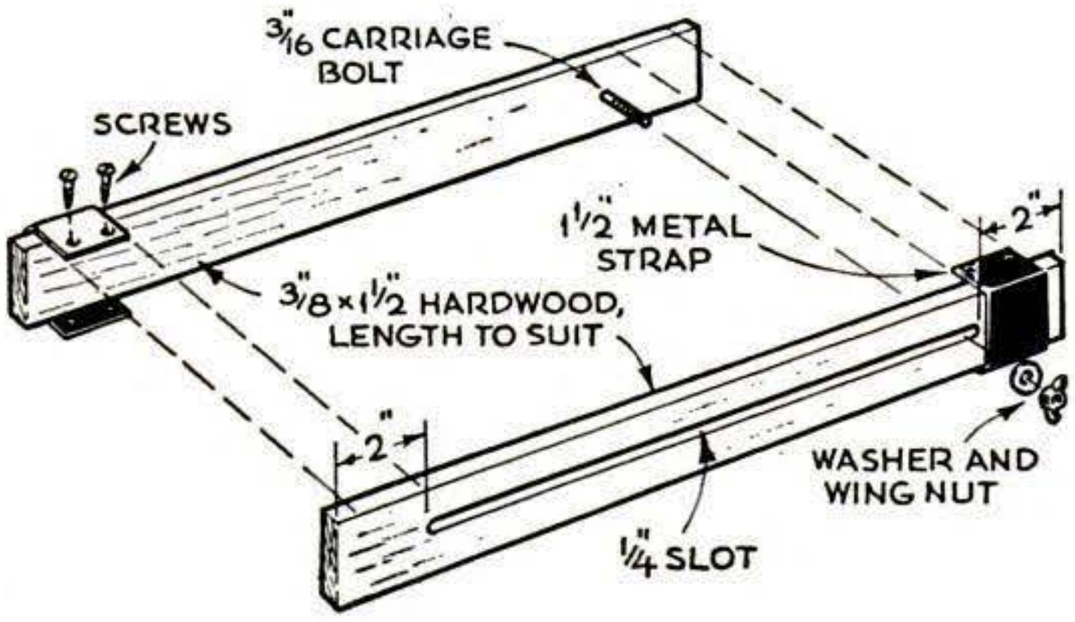


C Clamp Is Sawhorse Vise

A C CLAMP fastened on the end of a sawhorse makes a neat device to hold lumber for dressing. The clamp is welded to a hasp which is then screwed on the horse, as shown in inset. A tapered hardwood pin holds the clamp in locking position.—*Victor H. Lamoy, Upper Jay, N. Y.*



How to Make an Extension Rule

THIS sliding stick for inside measurements is made from two strips of scrap hardwood. Put a bolt through near the end of one and slot the other; then fasten the two together with strap metal, as shown in the drawing. Use a cardboard shim to provide some sliding clearance. —*S. F. Franklin, Port Stanley, Ontario.*

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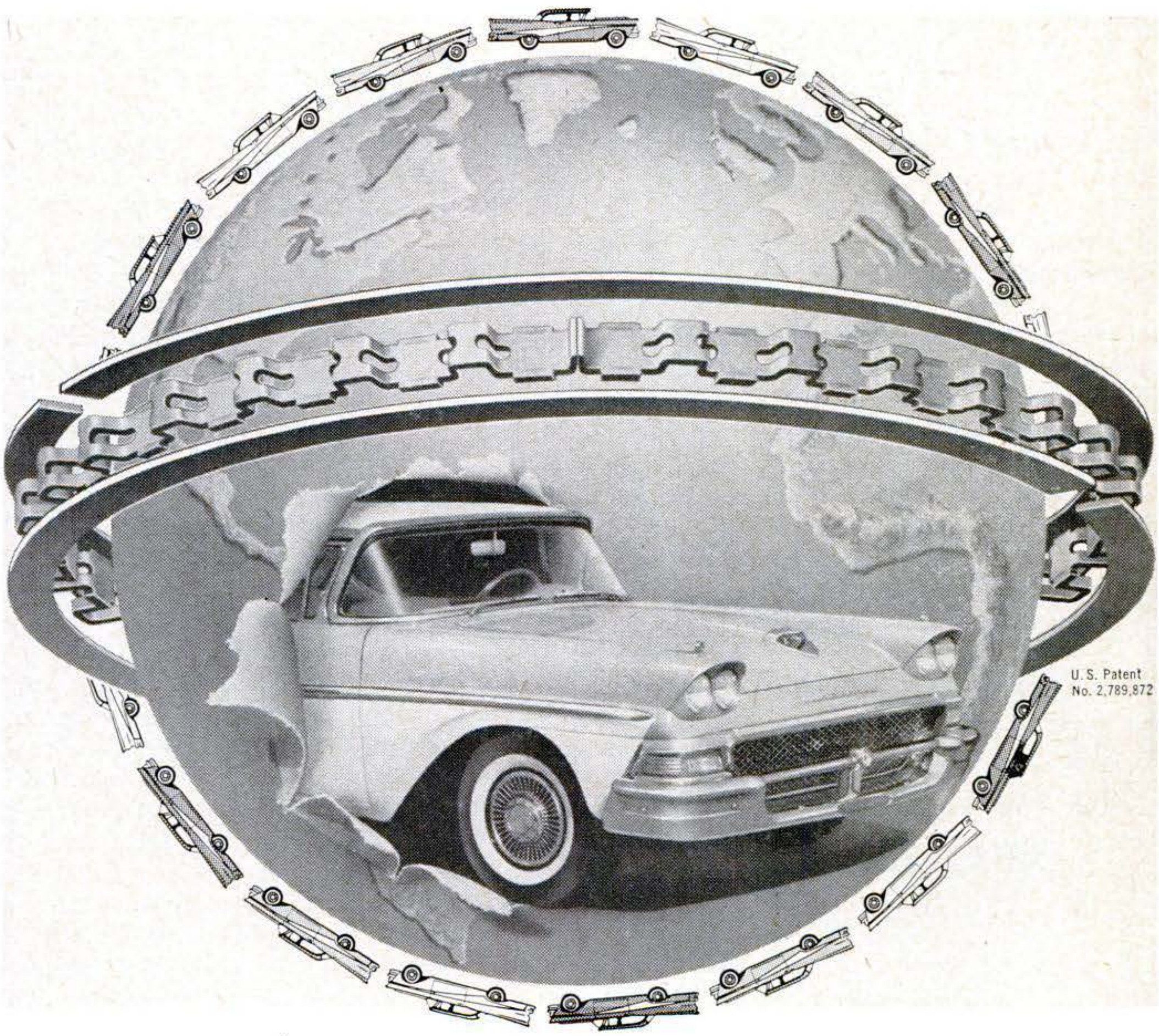
"Around the World" WITH FORD



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"HOW TO USE HAND TOOLS."

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S

Inside Russia by Car

[Continued from page 104]

rozhe we were stopped decisively by a militiaman. As we waited, the first of a strange procession appeared—two men carrying red flags, then two others carrying medals on red-velvet panels. Next came women bearing vast floral pieces, followed by perhaps 200 men, women and children and a small brass section playing stirring yet melancholy music. The slow procession trudged solemnly up a slope. Finally came a wooden casket, carried by several bearers.

Russian drivers are different. They are less competitive than we are, except in Moscow's heavy traffic. They are also notably helpful; if you run out of gas, you put an empty jerry can on the car roof—it will stop the first truck that goes by. And they seem rather fatalistic about breakdowns. Russian trucks get run to death before they rate an overhaul, so that many an off-the-cuff repair has to be made on the road. Russian mechanics impressed me. We had a difficult welding job done in Moscow; it turned out excellently. We also had a tubeless tire repaired there. The mechanic (who had never seen one before) not only fixed it, but achieved an airtight seal when he remounted it—he checked it in water to make sure.

To escape Zeleny Gai (O'Connor's Last Resort) on the trip back, we drove to Zaporozhe instead. It was here, on a Sunday night, that two teen-age machinist apprentices came up to us on the street and told us elatedly of Sputnik I. Later on, after our return to Moscow, we were approached by four students who had spotted us as foreigners and wanted to talk. I produced a copy of POPULAR SCIENCE with color photos of 1958 U. S. cars. Though calmly proud of Sputnik, the youngsters were frankly envious. "We won't have cars like that for two years," said one student. "Two?" scoffed another. "Ten would be nearer."

Because we had overstayed our visas, there were hints that we might have some trouble leaving the country. It didn't develop. We were courteously cleared at the Bug River bridge, and bade our guide and friend of three weeks goodbye. There was no inspection. We were allowed to take out all our film, to develop our impressions of Russia back home. END

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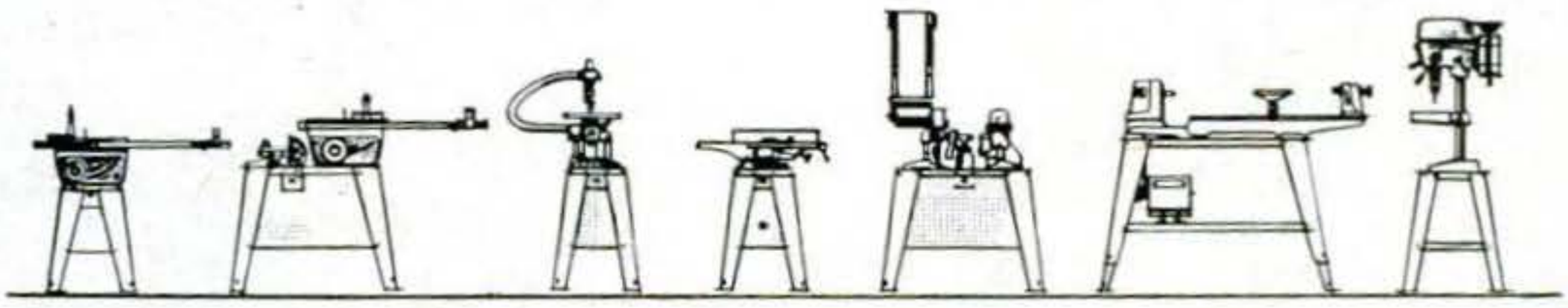

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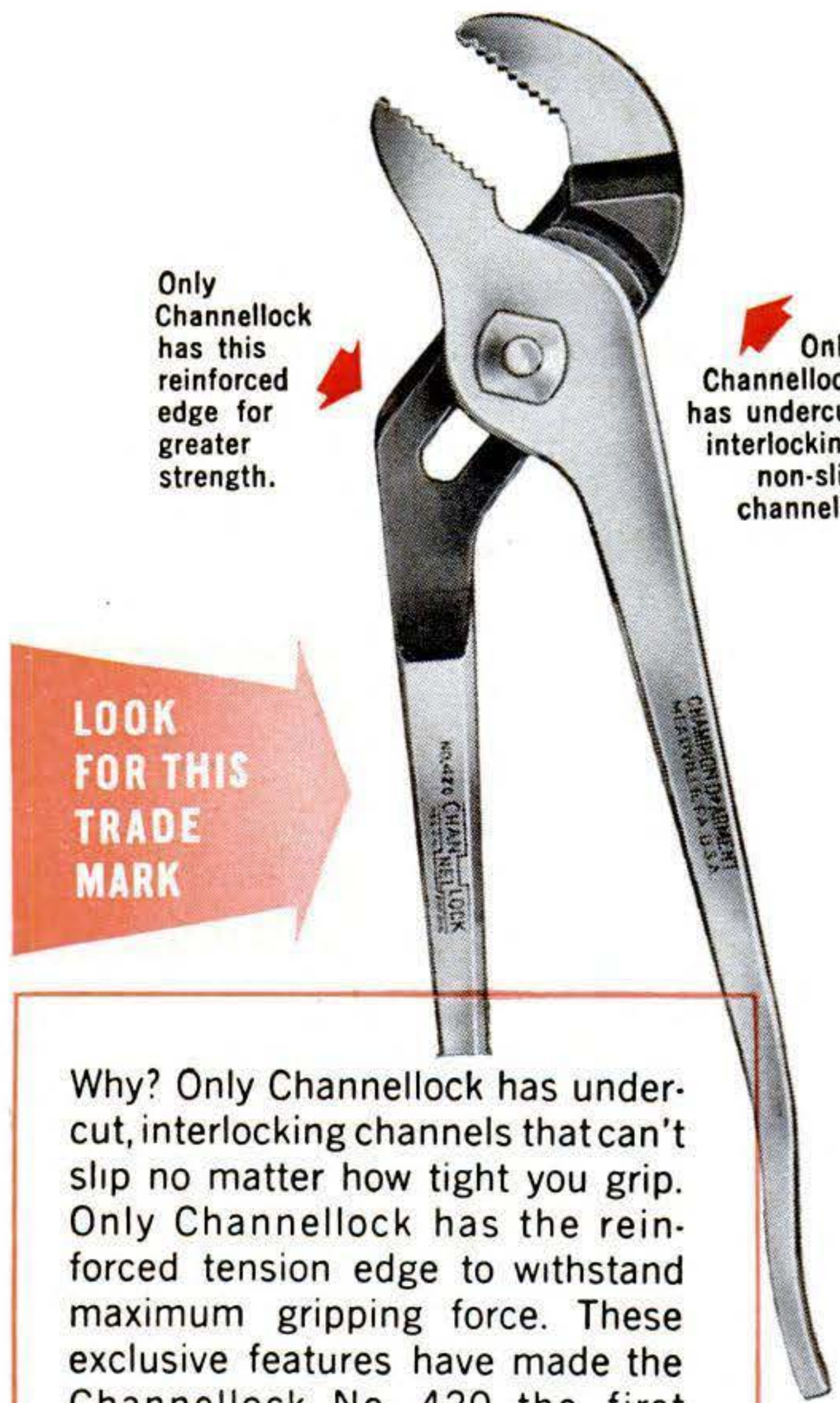

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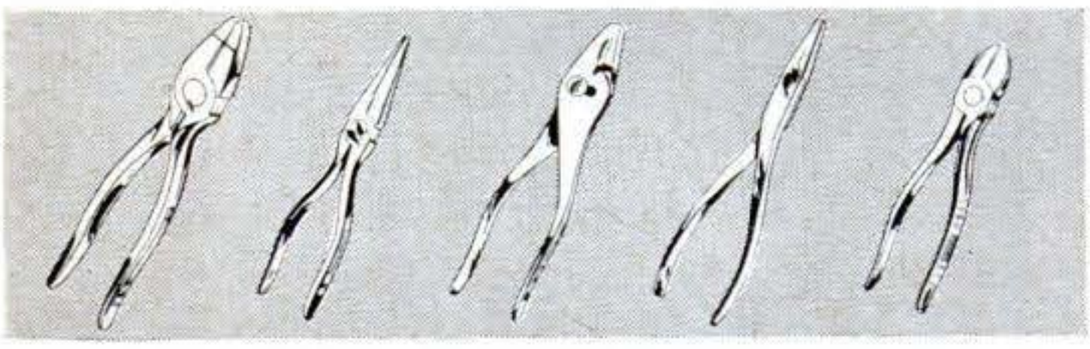

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What Science Knows About Headaches

[Continued from page 140]

itself, but acts by controlling painfully distended arteries.

This substance is extracted from ergot, a parasitic fungus that attacks rye and other cereal plants. For more than a thousand years, ergot has fascinated scientists. During the Middle Ages, ergot-infested rye flour was responsible for a strange poisoning, sometimes called St. Anthony's Fire, which periodically broke out in epidemic form and caused the death of tens of thousands of victims. Some of these unfortunates suffered from frightening convulsions. Others suffered from equally terrifying hallucinations.

In recent years, chemists have separated from ergot an array of different compounds. Some produce convulsions. Others induce hallucinations. One compound, ergonovine, stimulates the contraction of particular muscles, and is used now by many obstetricians.

For migraine victims, the most important ergot chemical is ergotamine. It and a synthetic derivative, dihydroergotamine, are now used for the control of migraine. They are reportedly effective in 80 to 90 percent of cases.

"No other headache remedy of any type," says one authority, "has yet been found to provide such widespread relief."

Drugs are not enough. Although the drugs can stop the pain of migraine in most patients, and ergotamine—usually in combination with caffeine—can often ward off an impending attack, they cannot cure the disease and prevent the painful bouts altogether. This requires some drastic psychological adjustment. For such an overhaul of emotions and outlook, one distinguished psychiatrist; Dr. Spurgeon English of Temple University, has offered this advice:

"This is not a perfect world. Families and friends have many foibles. Perfection is rarely attained, so be satisfied with less. . . . Do not be a slave to the clock . . . You cannot please everybody, so stop trying . . . Be efficient, but not to the extent that perfection becomes a burden . . . Speak up if you want to . . . Approve of yourself . . . And stop feeling so guilty. We are all human beings and we all make errors . . . Give a little and you will get a lot—maybe even a reduction of that pain in your head." END

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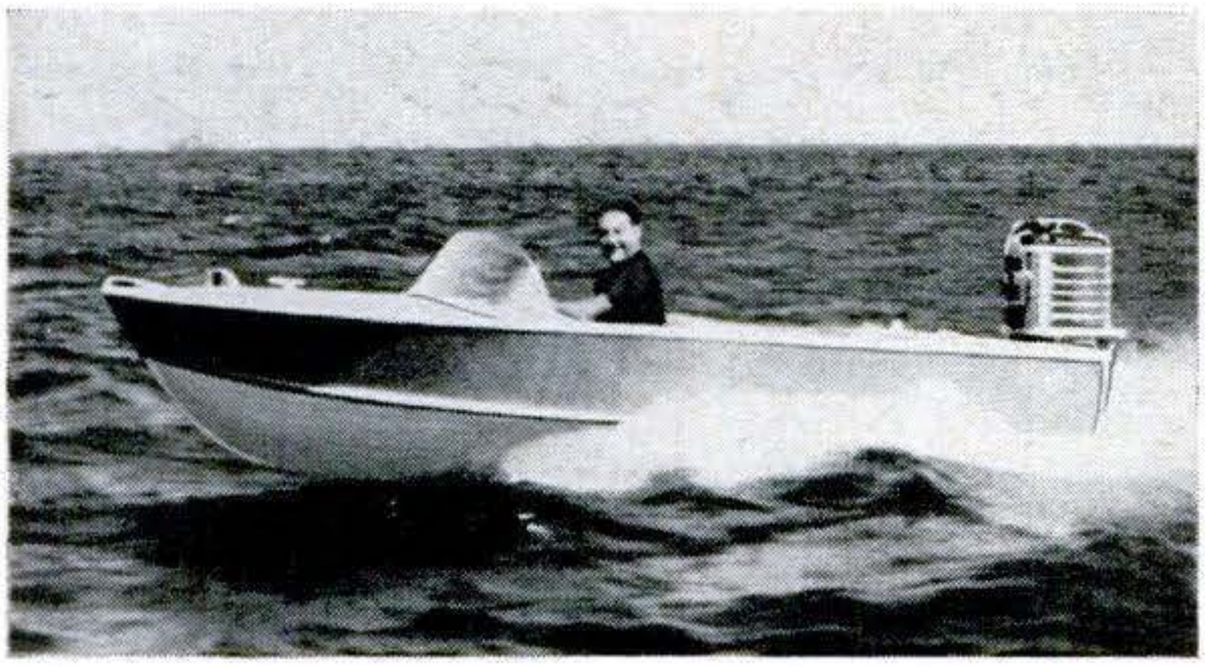
"Sweetest Music This Side of Heaven"



Guy Lombardo drives MERCURY's New Mark 78

"'Sweetest Music This Side of Heaven' has long been associated with my Royal Canadians, but after driving the new Mark 78, I'd say Mercury could claim it for outboards — on every score."

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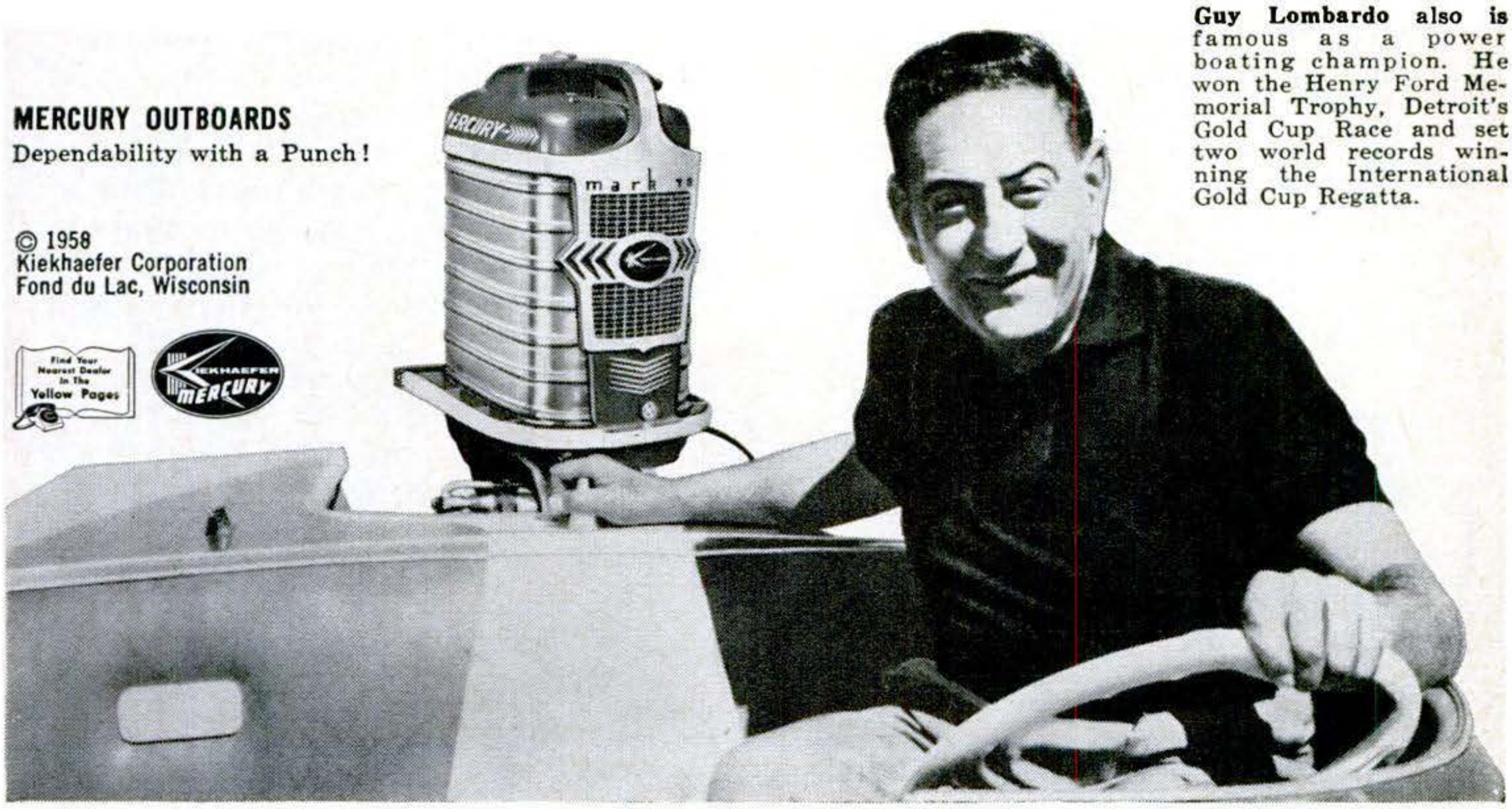

Guy Lombardo also is famous as a power boating champion. He won the Henry Ford Memorial Trophy, Detroit's Gold Cup Race and set two world records winning the International Gold Cup Regatta.

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[Continued from page 163]

off, there had not been an appreciable lessening of my momentum, as deceleration in the rarefied air was a slow decay. It was several minutes later and altitude was below 50,000 feet before the X-2 was subsonic again.

At 30,000 feet now, I did more maneuvers, approaching stall and then pulling up to test dive recovery, but my mind wasn't really on my work. Instead my head was filled with thoughts of the speed I had just attained, faster than any man had ever flown. I felt that I had made a contribution to mankind, a small step forward in aeronautical science—perhaps another step toward the time when men will fly in space.

Although I could not disclose my true speed over the radio for security reasons, I left no doubt that my flight had been a successful one. Congratulatory messages filled my headset, and when my chase pilots picked me up I did a few exuberant victory rolls.

At 20,000 feet we entered the overcast, breaking clear again at 16,000, where below me to the east lay the familiar runways of the dry lake. Waiting down there —as they always had—to see me safely home again, were the wonderful people who had made this flight possible. Also waiting for me, still unseen but felt more keenly than ever, was Avis and home. And I was free now to go on to my new assignment at the Armed Forces Staff College at Norfolk, Va.

Making my last landing at Edwards Air Force Base, I came in lower over the key point, chase planes with me and Maj. Childs talking me in. On the ground now, I touched down in a cloud of dust and skidded to a smooth stop, just 15 minutes after the drop from the B-50 a life ago. . .

Cindy and Vicky were at school when I got home, but five-year-old Kendall was in the yard digging. Avis ran out to the driveway as I jumped from the car, and hugged and kissed me. Her eyes were shining with joy and relief.

Over the luncheon table I still talked about the flight that morning, and she tried to appear interested. But I knew her heart wasn't in it, and after a while I began talking about other things. Besides, the movers were coming tomorrow, and I had to help her do the packing. END

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[*Continued from page 168*]

and that nixed the setup as a possibility for fusion power. If hot gas touched the wall, during a fusion reaction in a full-scale furnace, the tube would go right up in smoke.

So things stood, several years ago, in magnetic-bottle trials here and abroad.

What's happened since then?

Although much is still under wraps, there are hints as revealing as this:

"Some of the instabilities which did worry us considerably a year ago are now very well in hand," Congressmen were told in mid-'57 by the AEC's director of research, Dr. T. H. Johnson.

And the most impressive evidence of fusion-power progress is the beginning of big-scale experiments.

Currently the headlines are coming from England, where a doughnut-shaped thermonuclear machine named Zeta has already been in operation for several months. While its dimensions are undisclosed, there are indications that it's a sizable affair. The British experimenters report having attained temperatures of several million degrees—and believe they observed signs of a momentary fusion reaction. At this writing they were trying to confirm it. Such "flashes in the pan," which could occur at a lower temperature than a self-sustaining fusion reaction requires, would consume more power than they yielded; but they would be of great interest as an important step along the way.

In this country, a giant experimental thermonuclear machine, the Model C Stellarator, is scheduled for completion within three years at Princeton, N. J. Its shape and size are secret, but it will be so large that a special building will be required to house it, and an overall size of 100 feet is one unofficial guess. The AEC says it will consist essentially of a tube containing ionized gas, and external coils whose magnetic field will confine the gas, for attempts to heat it to "millions" of degrees and produce a fusion reaction. Auxiliary equipment will include a "huge" generator, power

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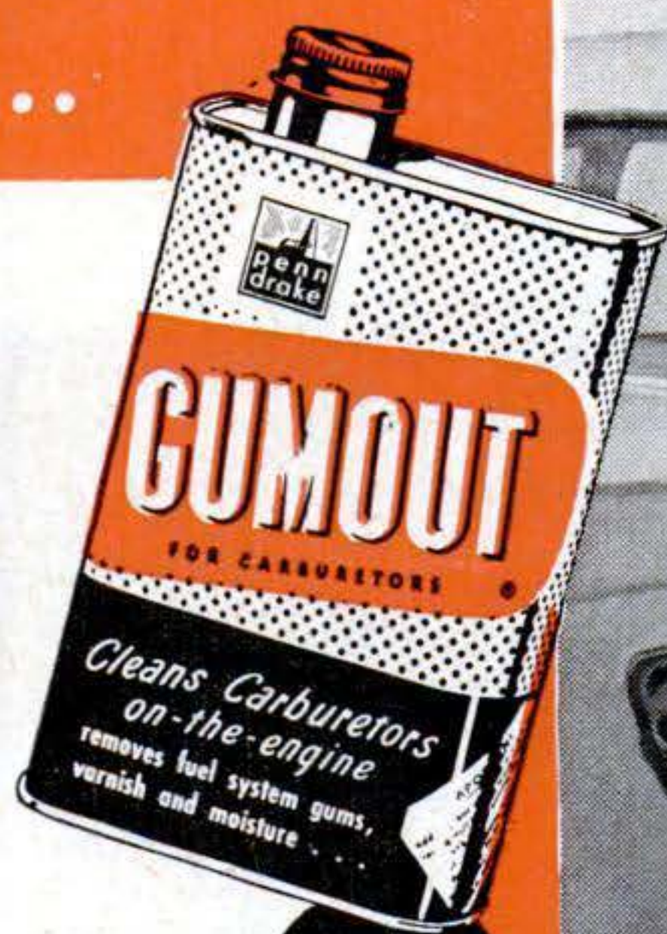

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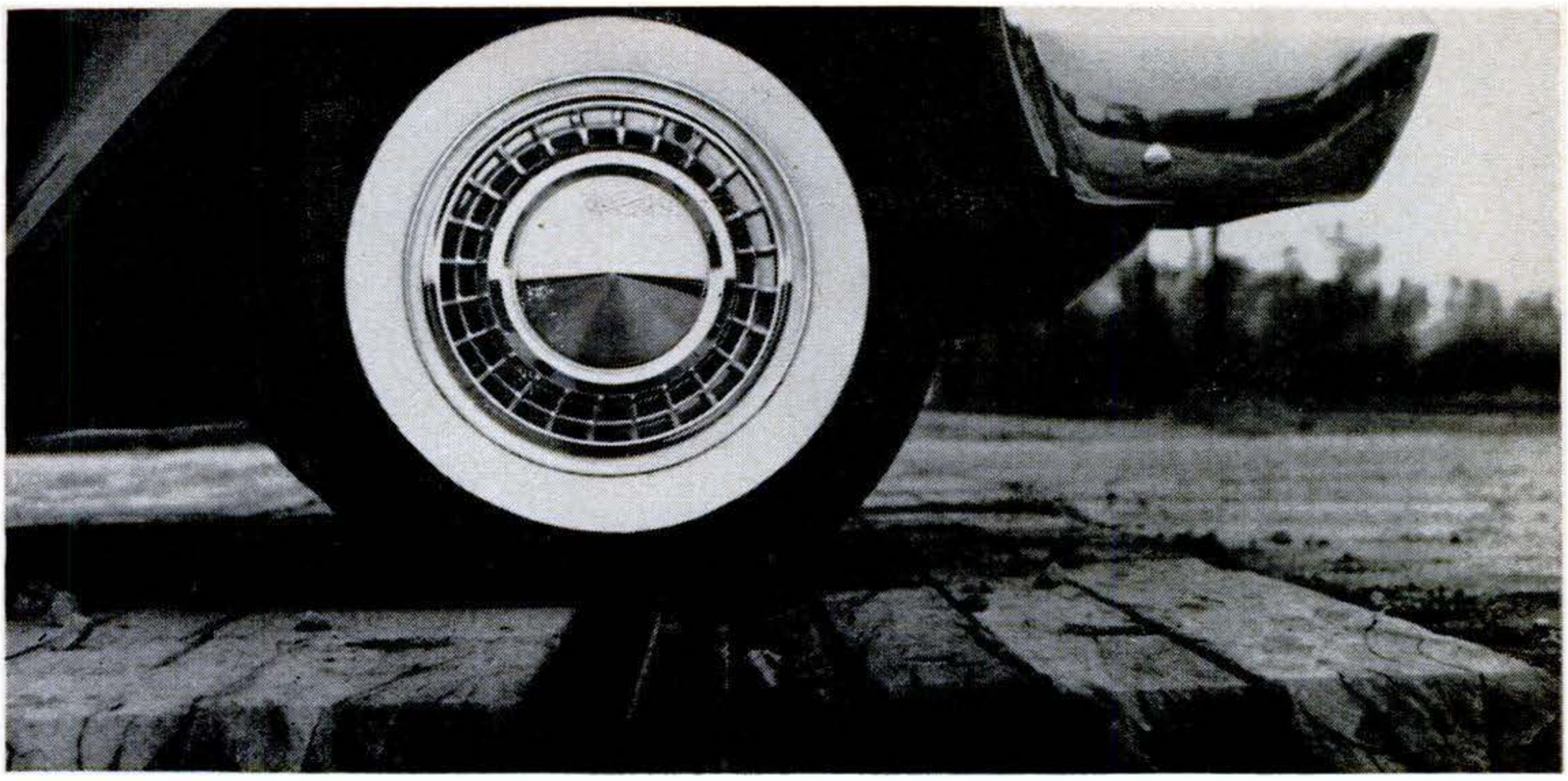

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Torsion-Aire is Chrysler Corporation's name for its rubber-isolated, ball-joint, anti-dip, torsion bar system of suspension. And it's unique among American cars. Its design comes from a fresh start, a clean drawing board. It is based on the belief that piecemeal modifications—and design compromises to accommodate optional suspension elements—are no match for a fully integrated, balanced system designed as a *whole*, with the *whole* car in mind.

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• Torsion-Aire is a complete system. It is designed "in depth" to eliminate your three biggest handling problems. No more starting squat. No more sway on turns. No more braking nose-dive.

• Torsion-Aire is standard equipment on *all Chrysler Corporation Cars*—and at no extra cost. Suspension isn't an accessory you can take or do without. It's as basic to the car as wheels.

• Torsion-Aire is a proven system. Unlike untried systems, Torsion-Aire has been proved by billions of passenger car miles—by more than a million satisfied owners.

Want more proof of Torsion-Aire superiority? Take the Torsion-Aire road test. You don't have to seek out special conditions. With a bump in almost any block—and a corner at the end of it—you can prove this new kind of ride to yourself in the first quarter mile!

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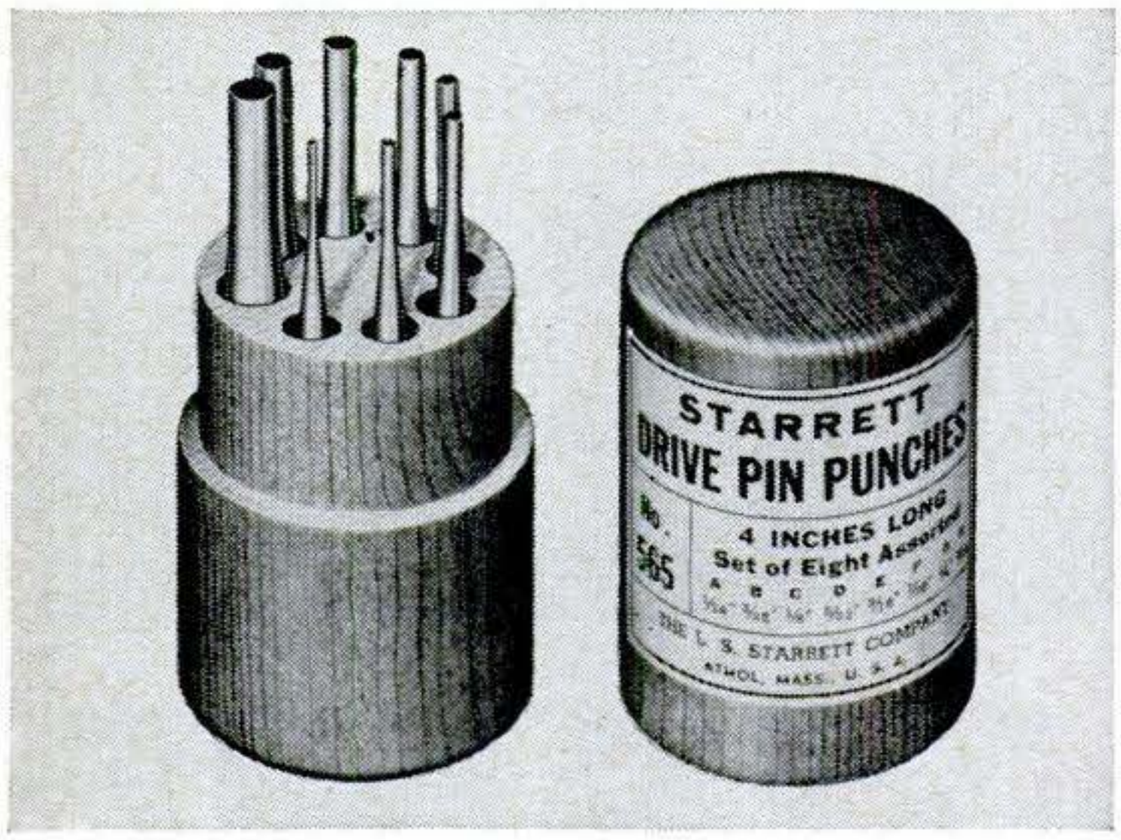

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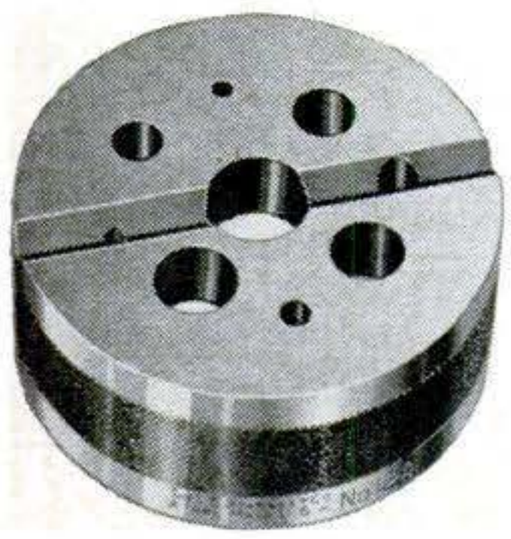

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condensers, electronic gear, and vacuum apparatus.

Apparently, with this machine, U. S. scientists hope to bring off the first sustained controlled-fusion reaction.

That would be a feat as memorable as was the achievement in 1942 of the first self-sustaining chain reaction in an atomic pile.

Suppose they do get a controlled-fusion reaction. How would they hitch it up to make wheels go 'round?

You could use the heat to make steam and run a turbogenerator, just as they do now with a fission reactor. It would be grossly inefficient, though, to apply an astronomical temperature just to heat steam a few hundred degrees.

Is there a better way?

The dream is to turn the heat of fusion directly into electricity, in such a way as this:

First the plasma is compressed by a magnetic coil. Then, as fusion takes place, heat expands the plasma and drives it outward again. That induces a current, in the windings, which you can draw off for power. Keep repeating the cycle, and you get a steady flow of electricity from fusion. You could compare it to a gasoline or diesel engine, in which the piston compresses the fuel, and then the ignited fuel expands and drives the piston.

Will a fusion-power plant be dangerous? Could it blow up like an H-bomb?

No, because only a tiny amount of deuterium will be in the furnace at any time—just enough to supply the wanted power, and much too little to make a bomb, or stoke a dangerous runaway reaction.

And unlike a fission-power reactor, a fusion furnace would store up no large accumulation of dangerously radioactive fission products, whose accidental escape could imperil a countryside. The only radioactivity of a fusion plant would consist of the extremely short-lived neutrons, and any moderate radioactivity that they imparted to nearby materials.

So it looks as if a fusion reactor should be the safest kind of all. END

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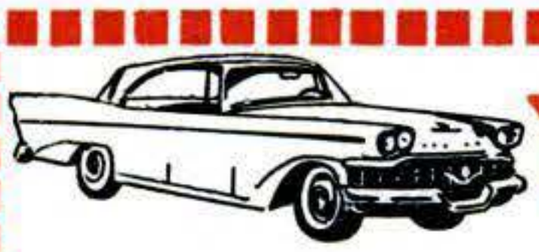

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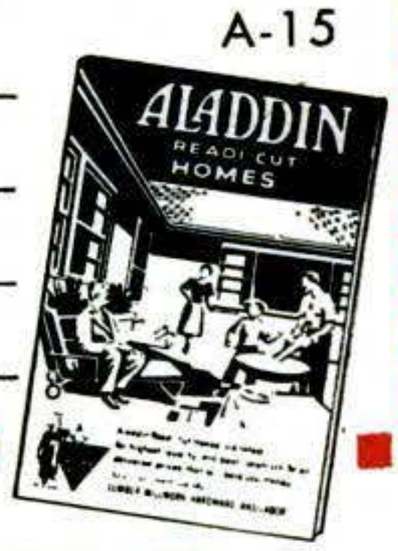

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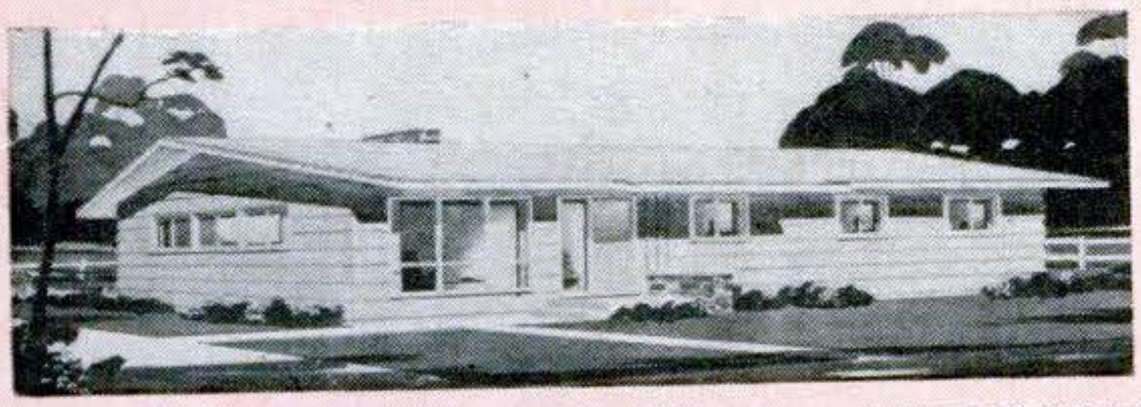

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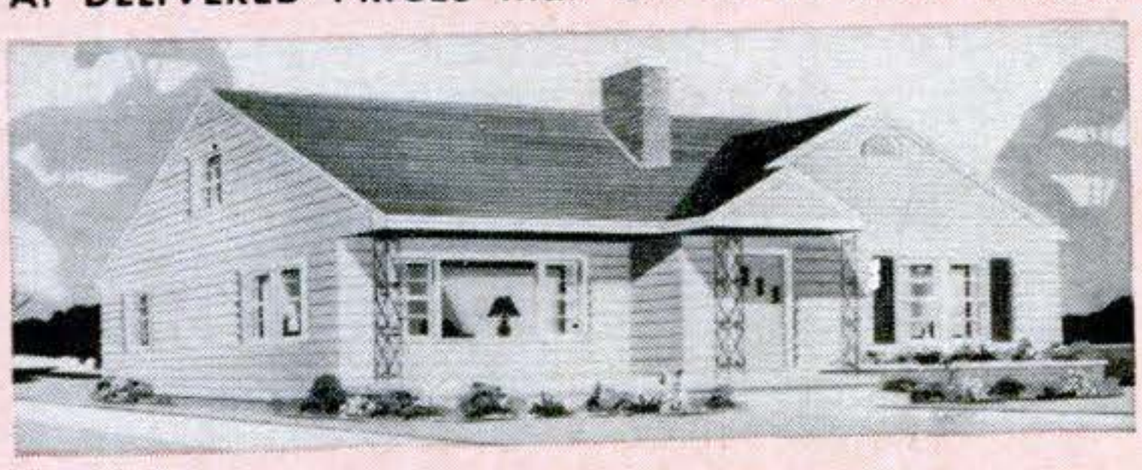

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Biggest Boom in Music

[*Continued from page 159*]

wind chest and the pipes that it feeds.

The levers are controlled by keys, and when an organist presses one, air rushes through the selected pipe. The pitch of the resulting sound is governed by the length of the air column, while the quality or character of the voice is largely determined by the formation of the pipe end. One type—similar to a penny whistle—has a sharp metal lip that partly blocks the passage and sets the air column into vibration. The sound it produces is quite different from that generated by a vibrating reed in the oboe-like pipe.

This wind-and-whistle principle has been found capable of producing four different families of voices. The distinctive organ sound of air sighing through pipes is known as diapason; interposing a vibrating valve between pipe and air supply adds a tremulous quality. The three other classes of organ voices are called reed, flute and string for the obvious reason that they are imitative of these instruments. Within each family, however, there are almost endless variations—just as there are real flutes of different lengths and string instruments as unlike each other as the harp and the banjo.

As the organ builder's art progressed over the centuries, separate organs were frequently combined into single instruments by the addition of extra ranks of pipes. To bring them under the control of one player, extra keyboards, or "manuals," had to be added to the console. Church organs of recent times have rarely had fewer than three manuals plus a pedal keyboard. When "couplers" were added, any rank of pipes could be played from any keyboard, and several voices could be played simultaneously for ensemble effect.

Because of their great size, complexity and cost, pipe organs were limited for centuries to churches and palaces. Their pipes, accordingly, were fashioned to produce tones of solemn dignity.

Now, since most pipe-organ voices are only imitations, it follows that there must be other ways—possibly better—to produce these sounds. Among the more practical means is the reed-organ principle in which compressed air is used to vibrate thin blades or reeds. Each key of a reed-organ manual controls a valve. Pressing

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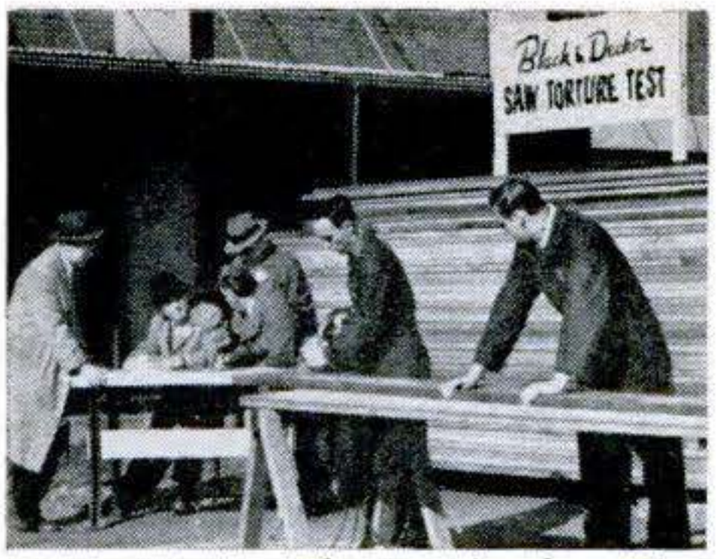

10:05 A.M. The test begins. The B&D Saw will be tested on 2″ lumber, making a variety of cuts.

4:00 A.M. It's 18 hours since the test began. Over 4000 ft. of lumber cut so far.

8:30 A.M. Over 22 hours and a third crew of men is on. 13 blades have been used.

Test runs through the night. After 24 hours, saw was still going strong. It was then put on laboratory testing machine to continue test* for 6 more days and nights.

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Hour after hour, day and night—for one week, a Black & Decker Saw was tested continuously by the United States Testing Company, Inc., Hoboken, N. J. This saw received more wear and tear than most saws ever get in a *lifetime of use*.

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**United States Testing Company, Inc., Report No. 37135, Nov. 27, 1957.*

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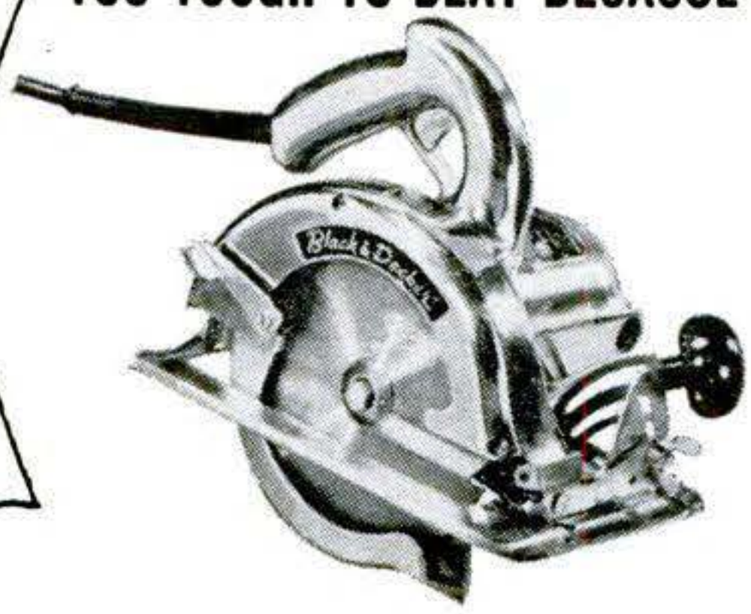

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a key allows inrushing air to flutter the appropriate reed.

Like church organs, most reeds of the last century were built with reverent voices, and the two types shared still another characteristic: They had an appreciable time lag between the pressing of a key and the sounding of a tone. Added to the religious associations of the instrument, this slow response tended to limit organists to the performance of sacred—or at least stately—music.

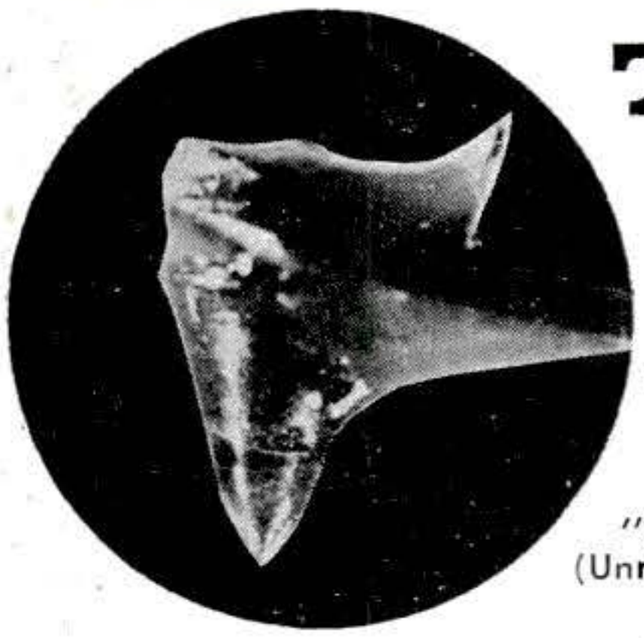
Thus while the modern organ can trace its lineage back to ancient pipes and reeds, its marriage to popular music took place only a generation ago. Many observers believe that it was the nickelodeon that brought them together. In the days when dialogue was printed on the screen, it was considered necessary to supply musical sound effects and accompaniment. Thus larger theaters turned to organs.

"Mighty Wurlitzers" (named for their innovator and principal maker) filled picture palaces with sound. The organs were specially built to give fast key response and highly theatrical effects. The Wurlitzers' showiness came, literally, from pulling out every stop. Extra degrees of vibrato were added, and new pipes created to simulate such unchurchly instruments as the saxophone and trombone. A variety of instruments that couldn't be imitated (such as snare drums, xylophones, and marimbas) were actually built into theater lofts and connected to the organ consoles.

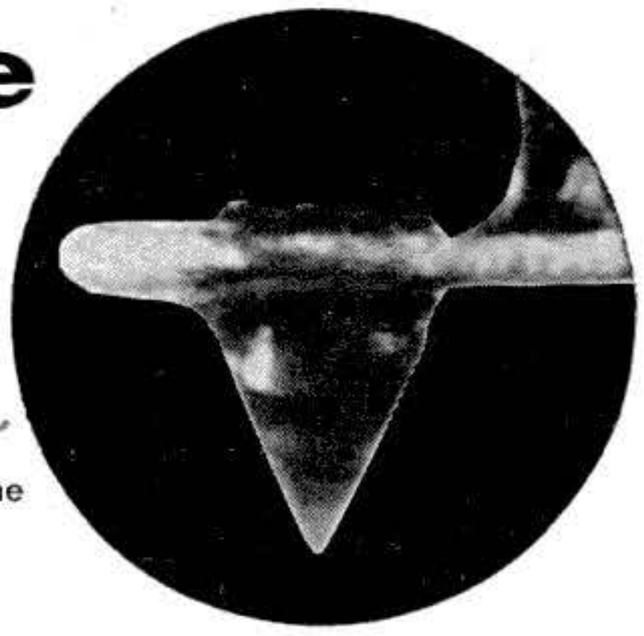
The enormous bounce and musical variety of these theater models added new dimensions to organ music and created a wide and enthusiastic following. They have also influenced the selection of voices and special effects built into most electronic organs.

Whether it's because of these new sounds, or their more traditional voices, modern organs are clearly riding a boom. The fact that most people (97 percent according to one survey) find organ music pleasant is expected to help. So is the snowballing effect that comes from increased exposure on radio, television, hi-fi recordings and in the home.

Convinced that the trend is leading



The difference can ruin your records!



Enlargement of "bargain" stylus. (Unretouched photo)

Enlargement of genuine G-E diamond stylus. (Unretouched photo)

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A G-E replacement stylus is a precision-engineered assembly, designed and built by the same people who developed the famous General Electric cartridges. The diamond tips are painstakingly ground. Specially formulated damping blocks do not "fatigue" with age. Positioning of these blocks has been precisely calculated to bring you the smoothest possible frequency response.

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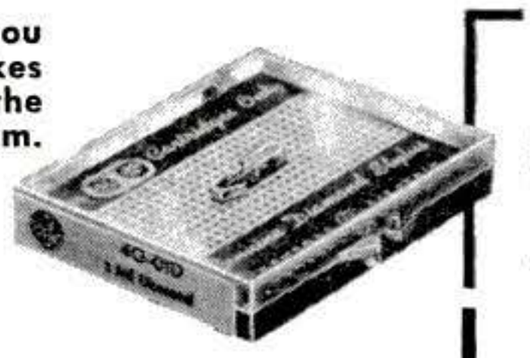

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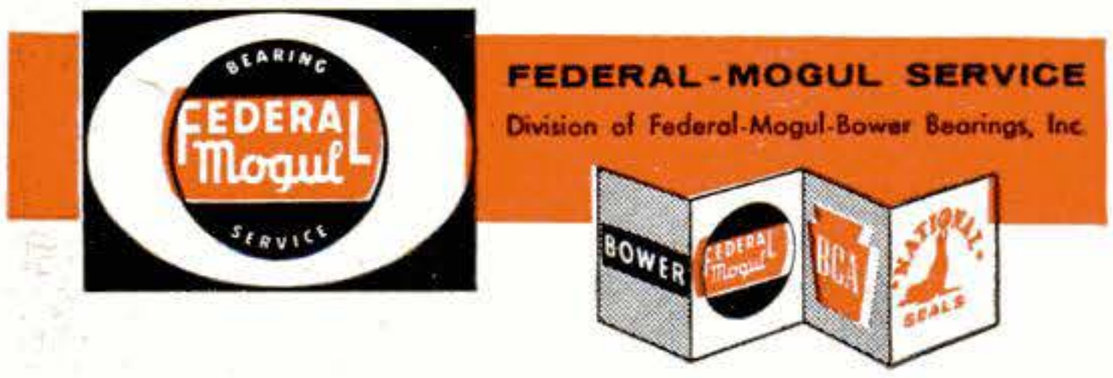

straight up, several manufacturers have expanded production and others have entered—or re-entered—the field. At least one firm offers a build-it-yourself kit of parts, others feature piano-organ combinations and organ attachments for piano keyboards.

One of the newest instruments to appear is based on a unique voicing system different from any of those mentioned above. Instead of generating organlike signals, the California-made Chamberlin uses tape recordings of individual notes taken from a wide variety of instruments. These realistic sounds play back when you press the appropriate keys. Other prerecorded tapes are provided for bass chords and special effects.

The swelling voice of electronic organs has been likened to the musical upsurge that put tens of thousands of reed organs —or harmoniums—into American parlors during the last half of the 19th century. But unlike the parlor harmonium—which filled an entertainment void in many isolated farmhouses—the electronic organ is successfully rivaling countless other diversions available in the home or a short car-hop away.

And there's another notable difference. The reed organ was commonly the focus around which the family would gather for hymn singing or just plain recreation. Though everybody joined the singing, there was usually just one who could play.

The electronic organ is a focus, too, but it is more often played by several members of the family. The ease of operation that has made this possible is undoubtedly the biggest factor in its sudden rise.

The love of music that most people have has been lavishly fed by radios, phonographs and a variety of other devices. The new organs, however, cater to what may well be a still more fundamental need—self-expression through musical creation. The playing of music has ceased to be a private and limited preserve.

Electronic organs, to be sure, offer many challenges to trained musicians. But their most enthusiastic fans are like the lady in Port Clinton, Ohio, who wrote to a manufacturer: "It has opened up a whole new world for the entire family. At present we are beginners, and can only play picture music, but it's wonderful and we love it." **END**

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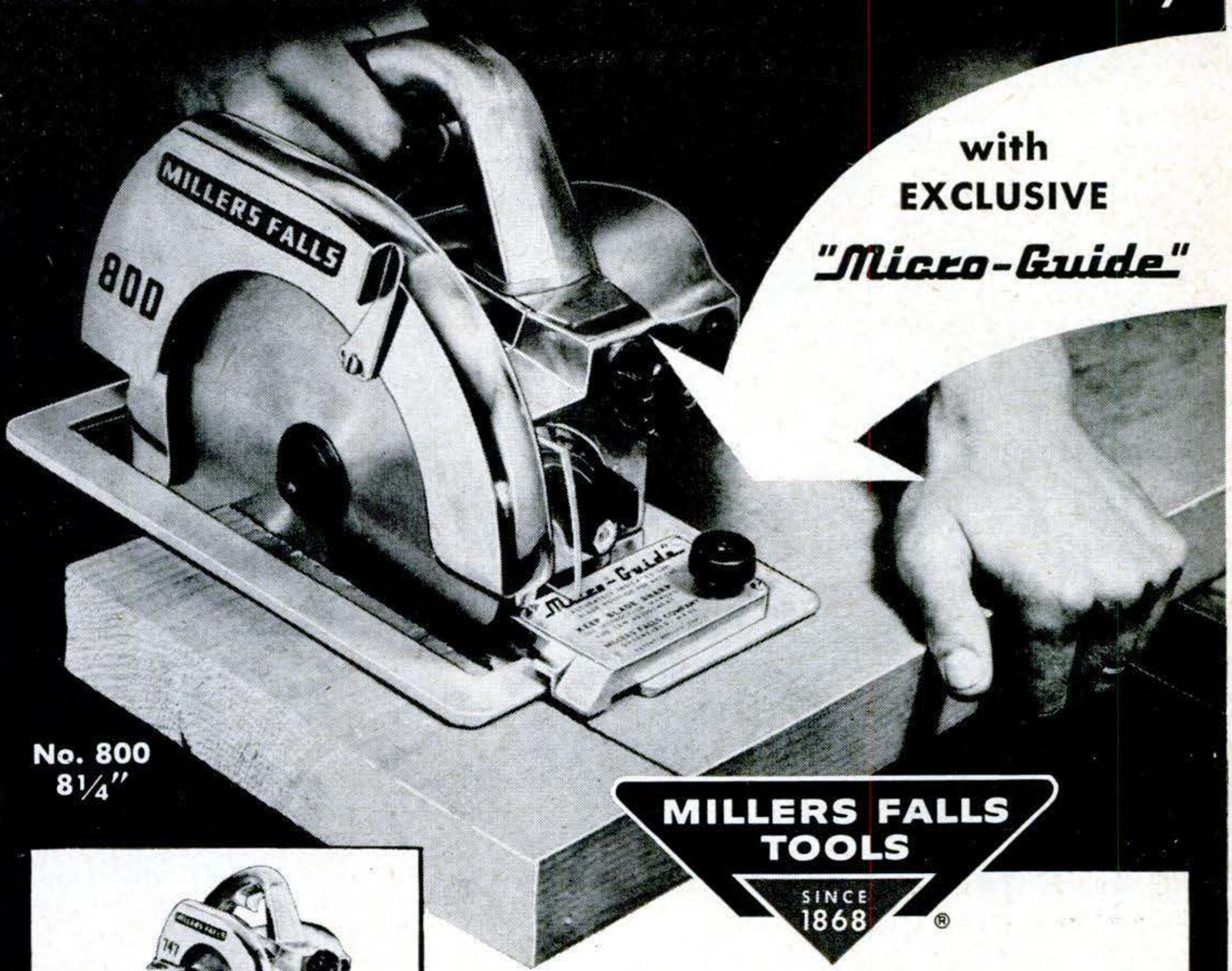

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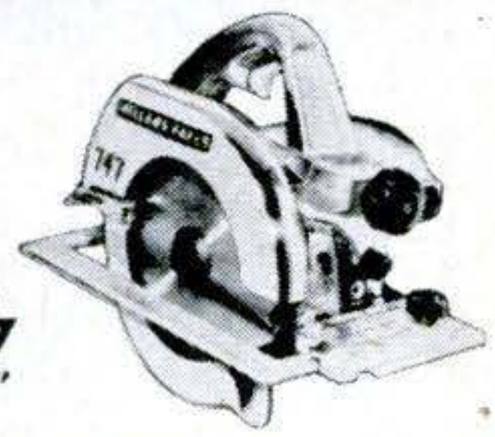
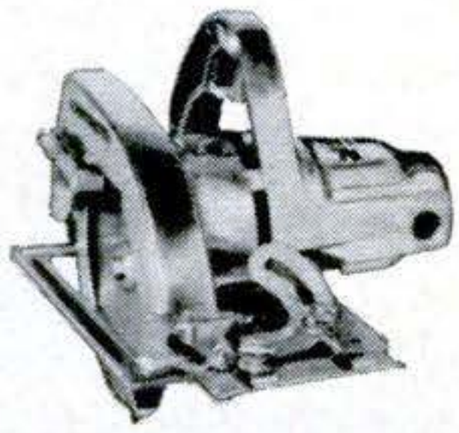


No. 747
7¼"

No. 727
7"



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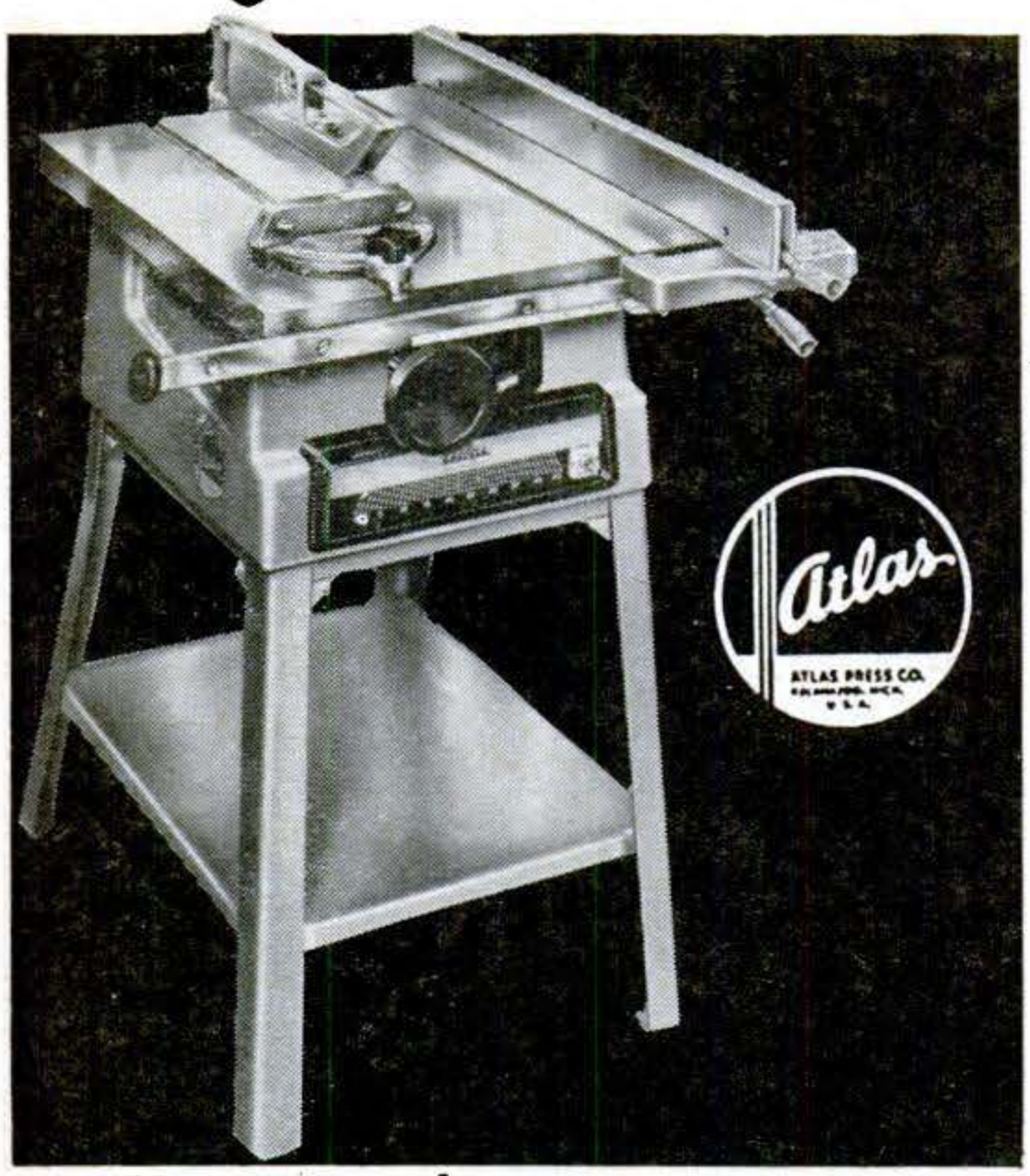

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Atlas 8" and 10" tilt/arbor saws have ground grey-iron tables, sealed-for-life ball bearings, patented quick-positioning double locking fence, grip-form mitre gauge, dual-control handwheel. The new structural box mechanism of the cradle and arm holds the blade in rigid alignment at every height, angle and cutting load (an Atlas exclusive . . . the most significant advancement in saw design in two decades). Unexcelled for general carpentry, these great new Atlas saws also give you the accuracy you need for fine cabinet work, built-ins, trim and furniture projects. See them and compare before you buy any saw!

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[*Continued from page 117*]

of its closed positions to the other."

"Say a chunk of ballast works up between the points and the backing rail, so the switches won't close?"

"That's CTC's second job. I've just told you how we use code signals to operate the switches and lights out here. But a second set of signals must go back to the control board to show that the field location has done its work. In the case of an open switch you're dealing with another transmission system called an 'audio frequency overlay.' "

"Come again?"

"Well, let's make it sound simpler than it is. At every block-signal location we send a tone signal through the rails. Now imagine a hi-fi-minded relay listening tight-lipped to this concert. When a switch isn't fully closed the tone signal goes sour and the hi-fi relay drops its jaw. That opens a circuit and the field location passes the word along to the dispatcher by refusing to give him a switch-position light on the machine. Then it's up to him to call the nearest maintainer."

Three streamliners and one redball freight later, we were back in the CTC office at Perry, watching relief dispatcher Bill Kelly plot his meets on the master keyboard.

"This CTC machine," he told us, "was actually built on the installment plan. The cabinet I use to handle trains for the first 60 miles out of Council Bluffs went into service first, at a station called Manilla. Then we put in the one at my right, for movements between Green Island and Marion Yard, near Cedar Rapids. When we closed the gap between them with the board in front of me, we had a problem—how to keep traffic rolling while we brought the small machines into Perry."

"That's when the signals-and-communications department made it easy for you train delayers," McConahay cut in. "We had our new carrier system all ready to tie on. Then we hooked temporary extension lines to the machine at Marion, waited for an open spot in traffic, and loaded it aboard a baggage car. A dispatcher climbed in after it and went on putting his trains across the road until a second traffic lull gave us a chance to cut the wires and high-tail the baggage car to

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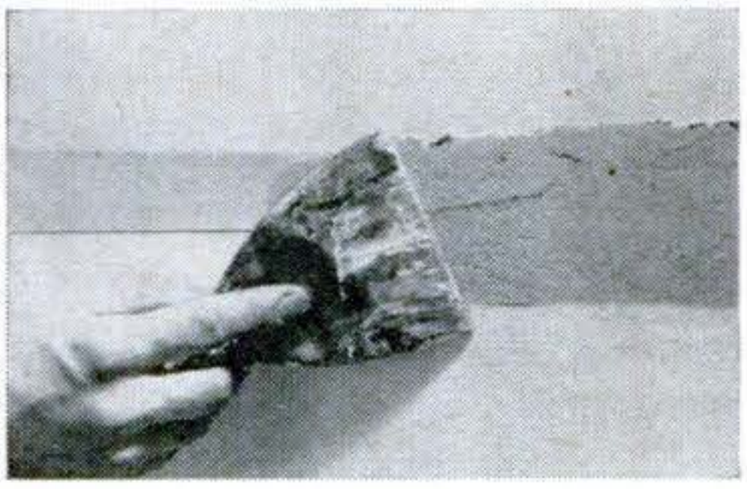
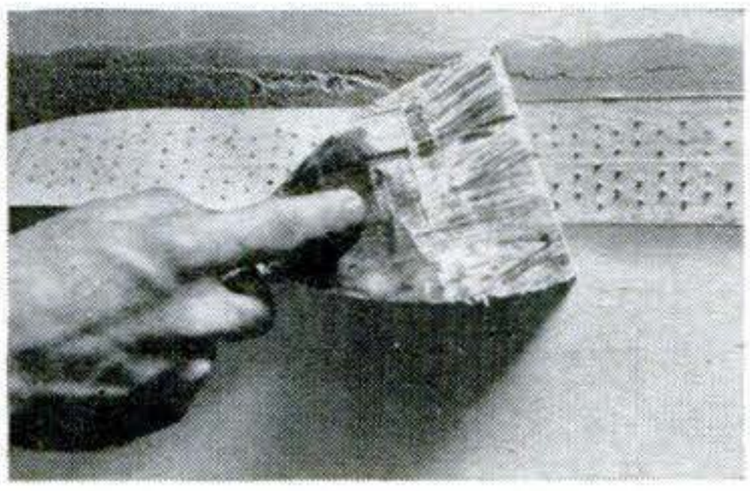
Get smooth, seamless walls with Gold Bond Gypsum Wallboard and Tape System

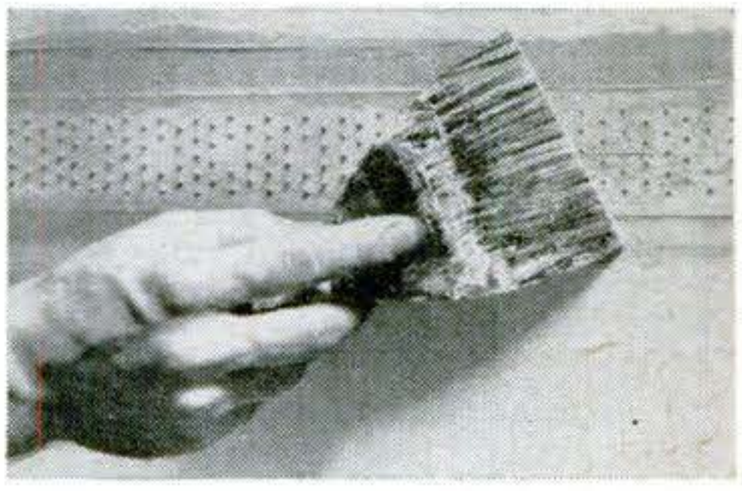
You can have expertly finished walls by following this simple procedure. Just nail Gold Bond Gypsum Wallboard to wood framing and treat the panel joints with Gold Bond's easy-to-use Perforated Tape Joint System. One package contains all the joint materials you need for the average room . . . including the bedding knife. Here is how it works:



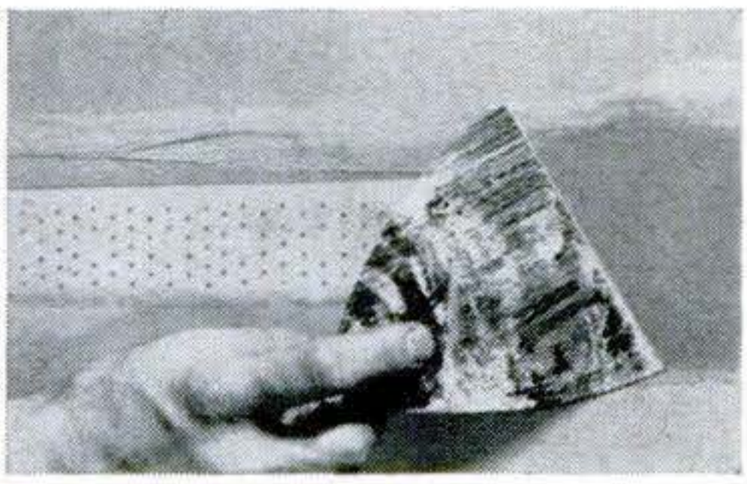
APPLY CEMENT. Fill each channel formed by edges of tapered-edge wallboard with Gold Bond Joint Cement.



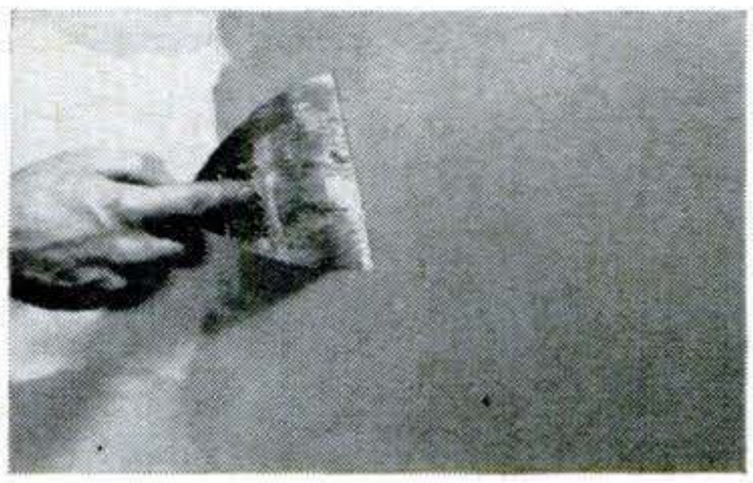
EMBED TAPE IN CEMENT. Center Gold Bond Perforated Tape in channel and embed in cement, using 4″ putty knife.



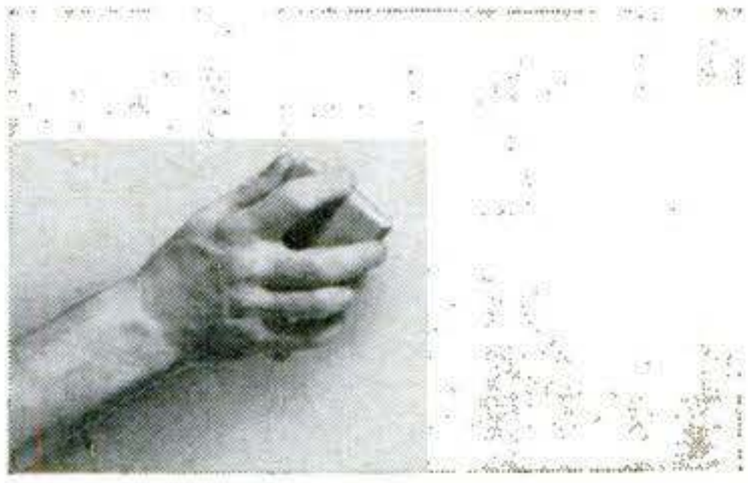
SMOOTH DOWN CEMENT. Smooth down cement forced through tape perforations. Cement all nailheads.



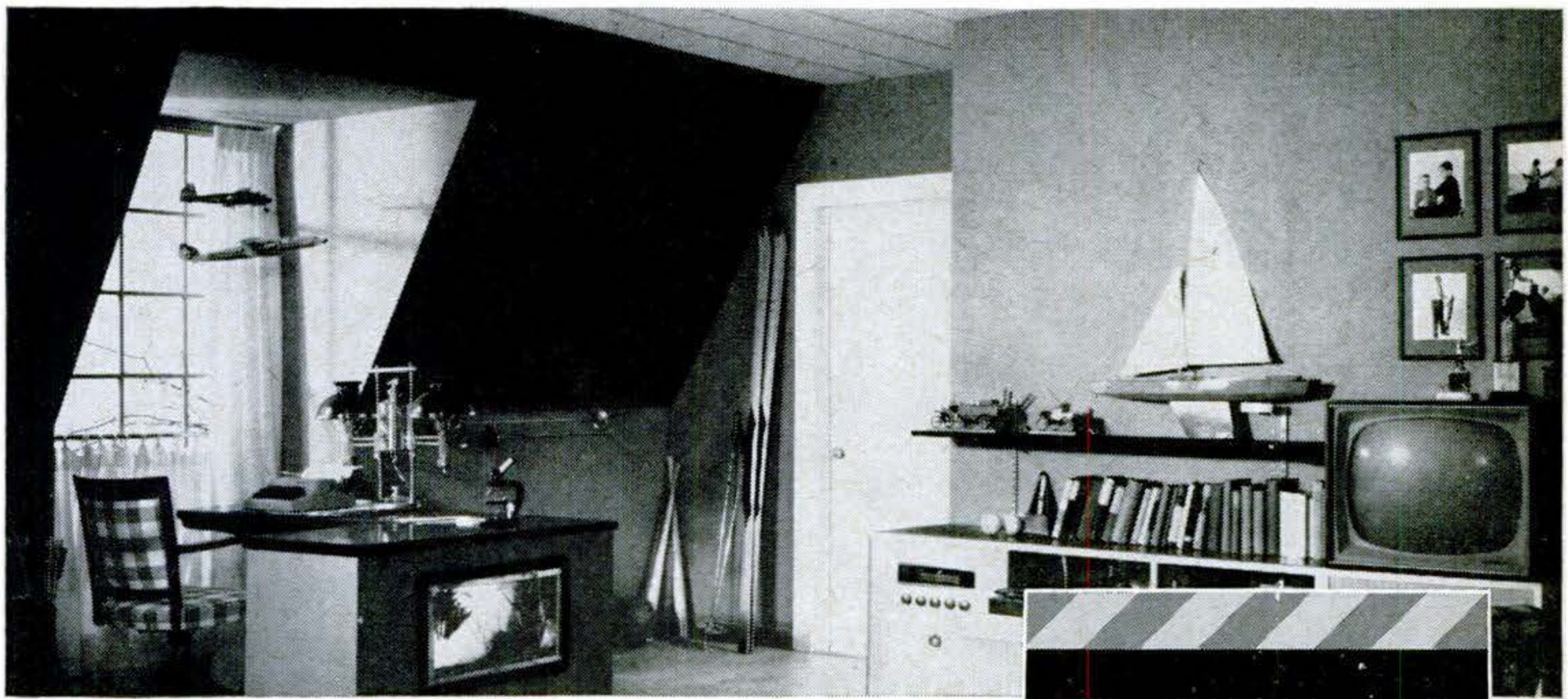
FIRST BEDDING COAT. After 24 hours, apply thin coat of cement and feather out 3″ to 4″ on each side of channel.



SECOND BEDDING COAT. When cement is dry, apply second thin coat. Feather out 8″ to 10″. Give nailheads second coat.



SANDING. After 24 hours, sand cement level with wallboard surface. Sand lightly—don't scuff paper surface.



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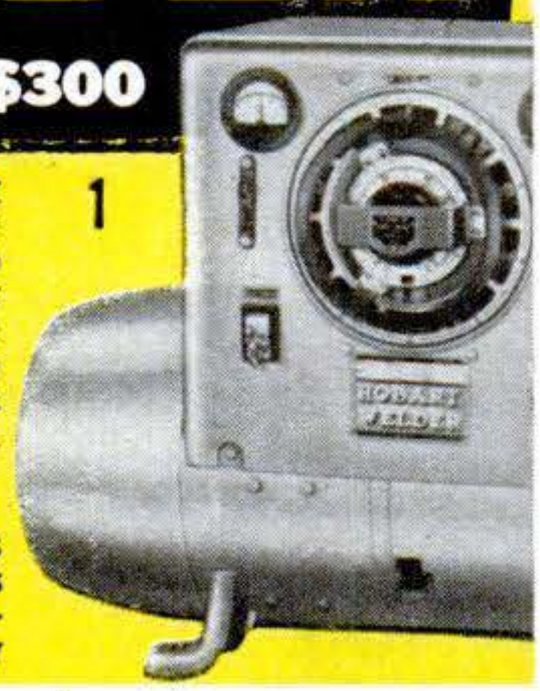

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Perry. The machine was back in business in a couple of hours. At Manilla we were able to make a transfer without the baggage-car hookup."

Like castanets, for the next six hours the relays behind the panels clicked steadily. Outside the office, unseen by Bill Kelly, a continuing parade of long yellow passenger trains poured in and out of Perry. Three of them, the "City of Denver," "City of Los Angeles," and "City of San Francisco," eastbound, chased each other across the board in the form of tiny lights that were rarely more than two reporting stations apart. "The minimum air cushion between those babies is four minutes," Kelly said.

Intermixed with the streamliners were the hardworking freights. The voices of trainmen with cars to set out and pick up on sidings came booming through a loudspeaker, requesting signal protection and the authorization to unlock hand-thrown switches. Each time, Kelly checked his board. If the move could be made without stabbing traffic, he flicked his levers and punched the right actuating buttons. As a further precaution, he slipped little composition tags over the buttons to lock them. He didn't remove them until he got a second call, advising him that the switching movement was complete.

Backing up Kelly, J. D. Galiher, night chief dispatcher at Perry, came in a dozen times for a look at the ribbons of tape that inched along below rows of magnetically controlled pens in front of each machine. As trains progressed across the division, they actuated the pens, one by one, and tiny jots appeared upon the ribbons. When Kelly connected the dots with his fountain pen, diagonal lines, moving toward each other, showed him where east- and westbound trains would meet, and when. He set his passing-siding switches and signals accordingly.

By dawn it was clear to us that Centralized Traffic Control is an infallible railroading robot. But it's a robot that makes stern demands upon its human co-workers. The real plaudits go to the McConahays who keep it healthy, and the Kellys who must make split-second decisions each hour of the day and night to take full advantage of CTC's amazing traffic potential. END

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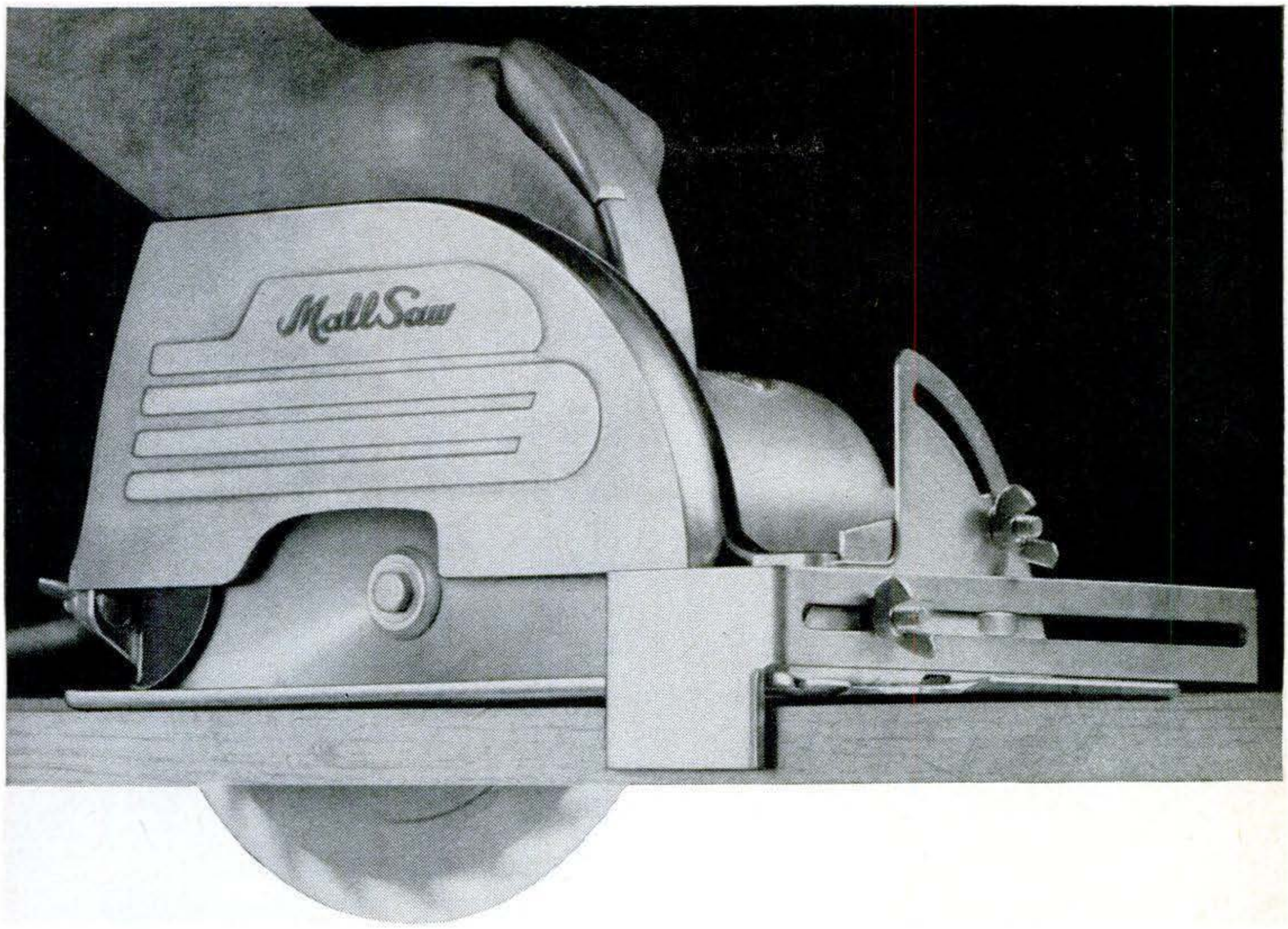

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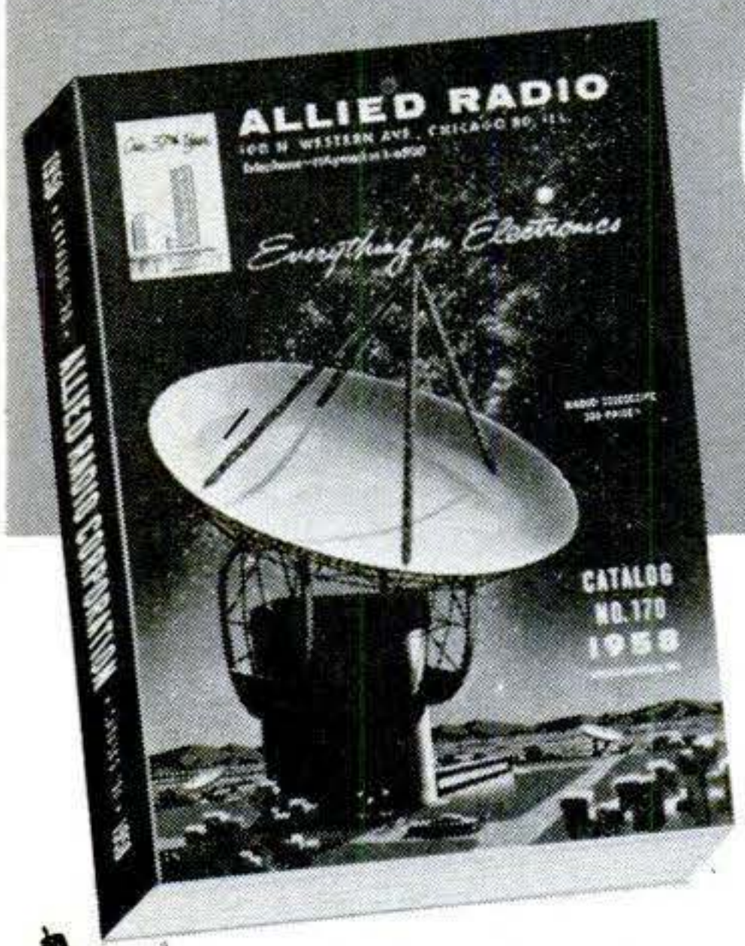

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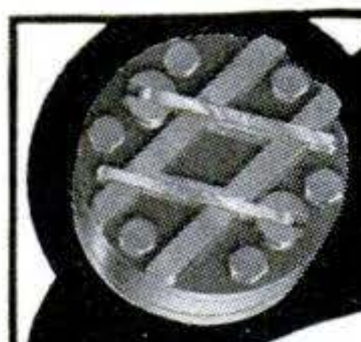

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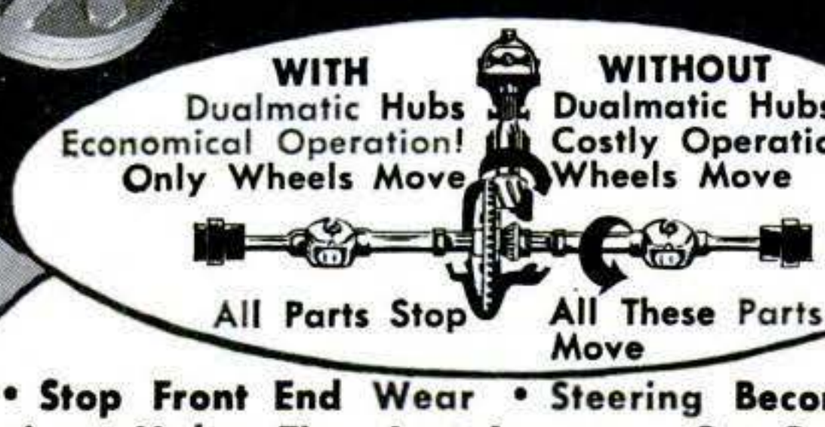

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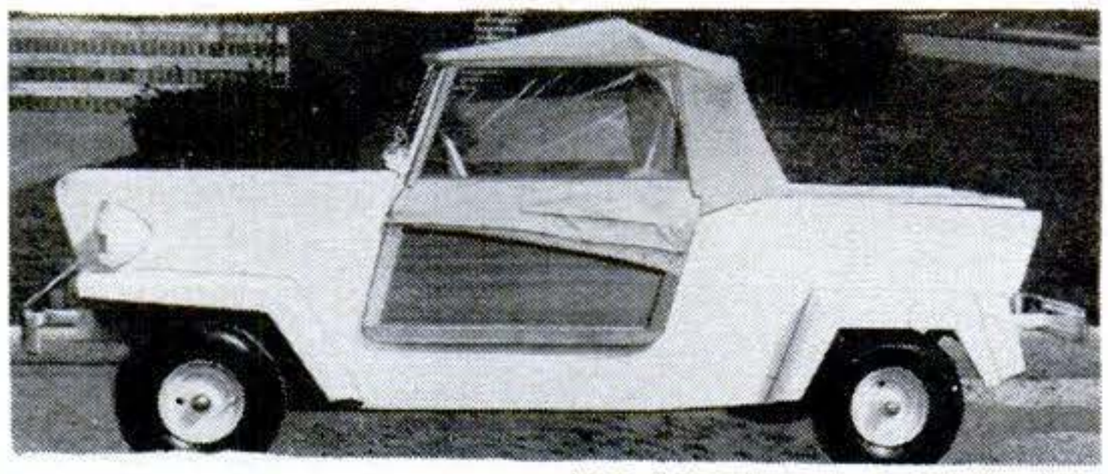

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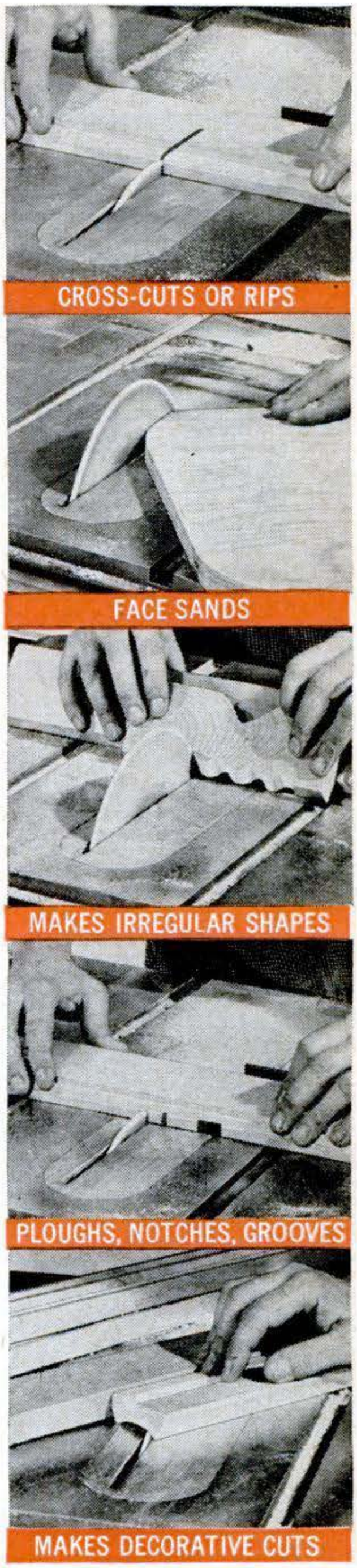

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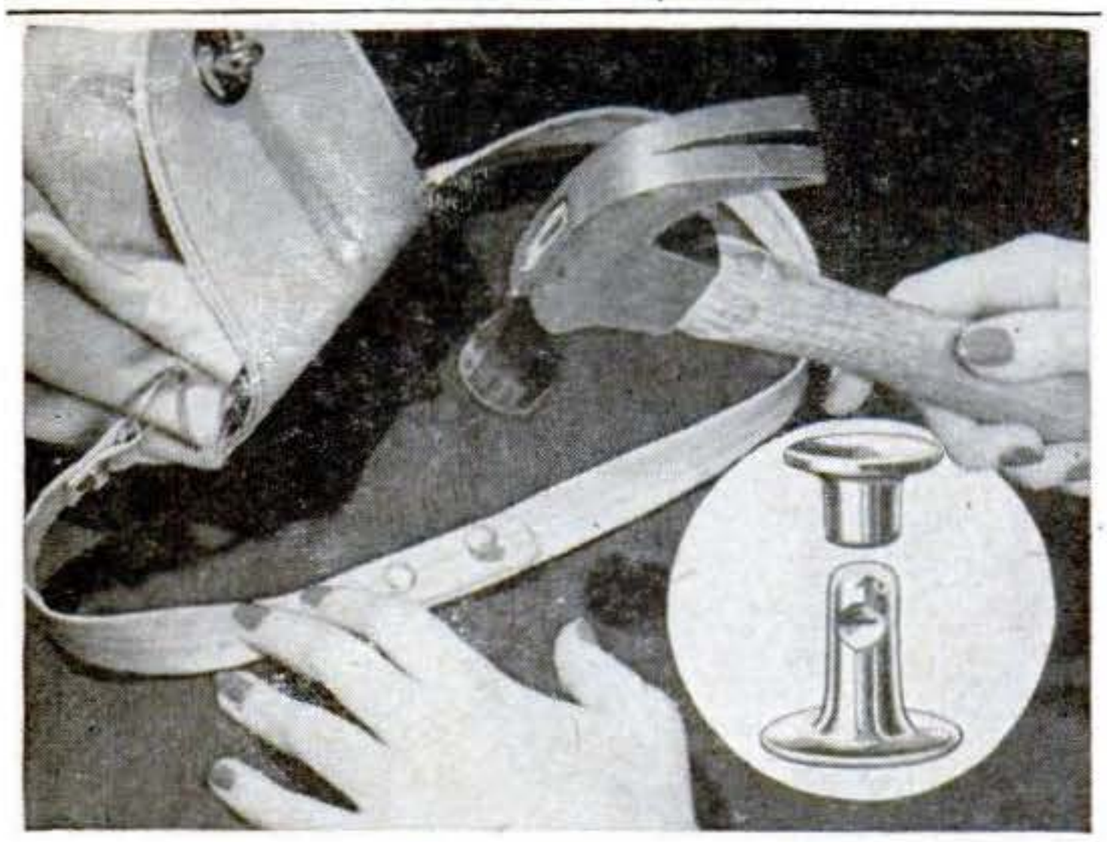

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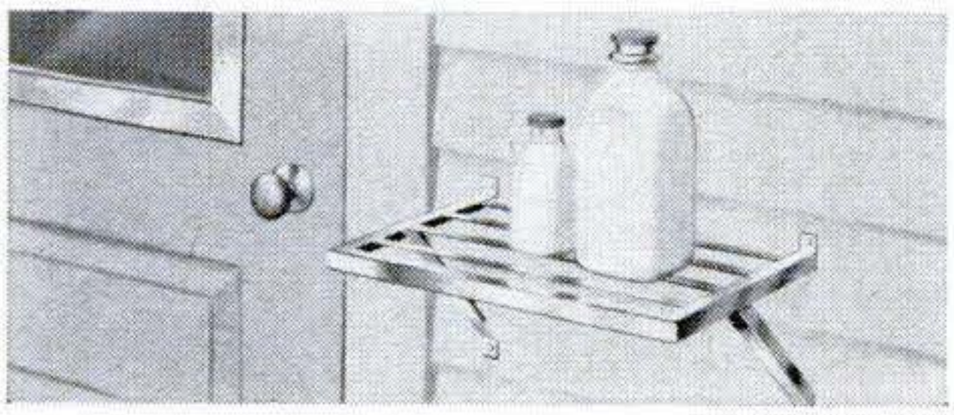

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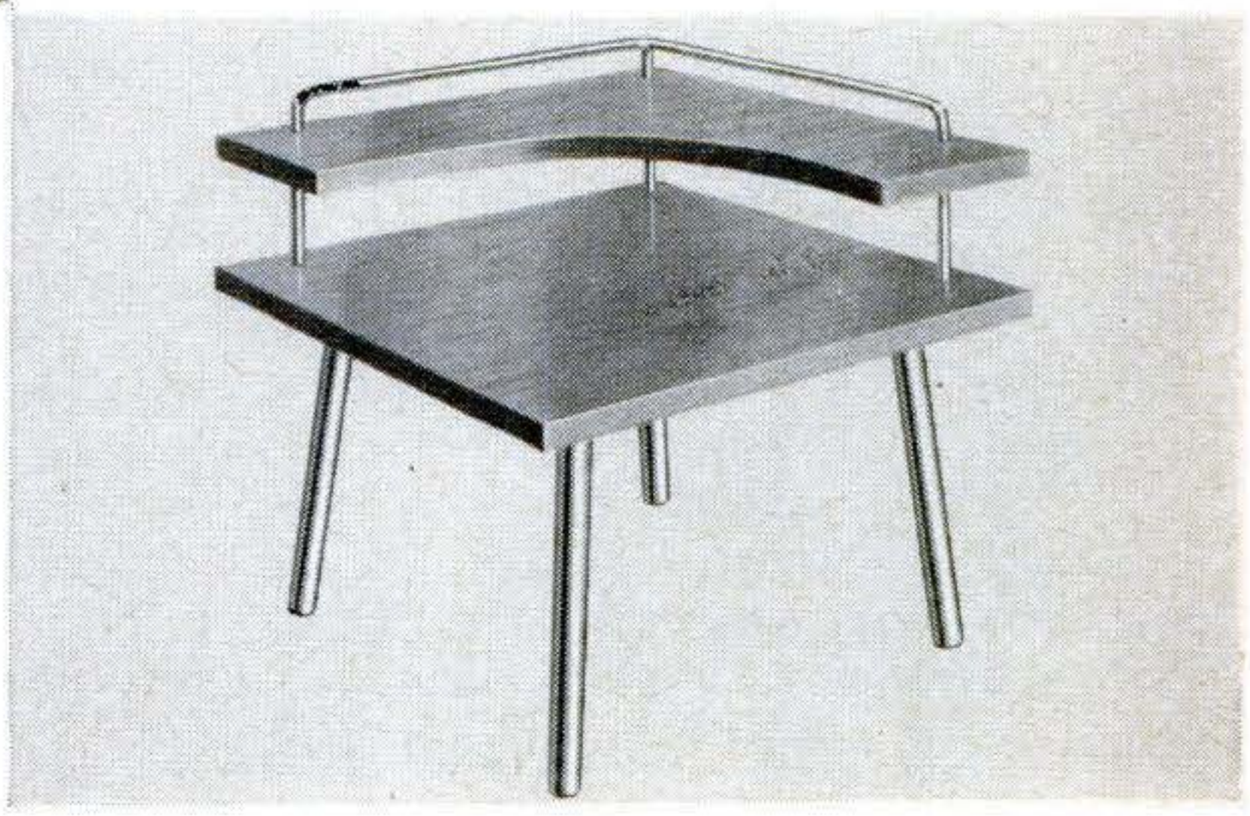

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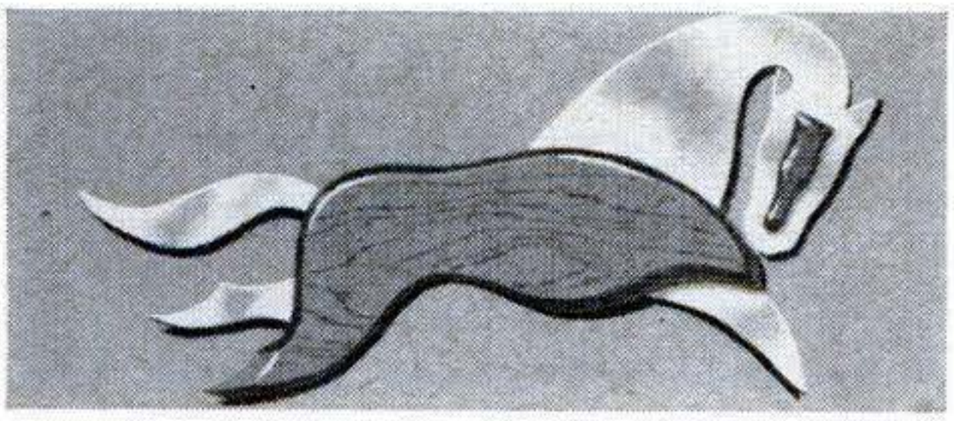

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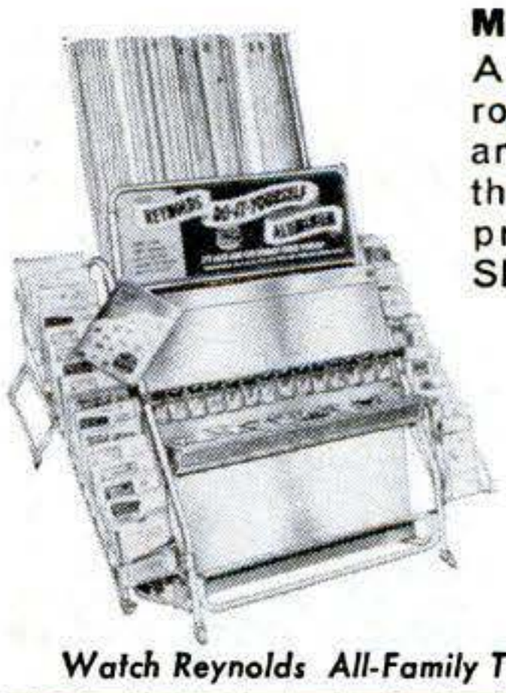

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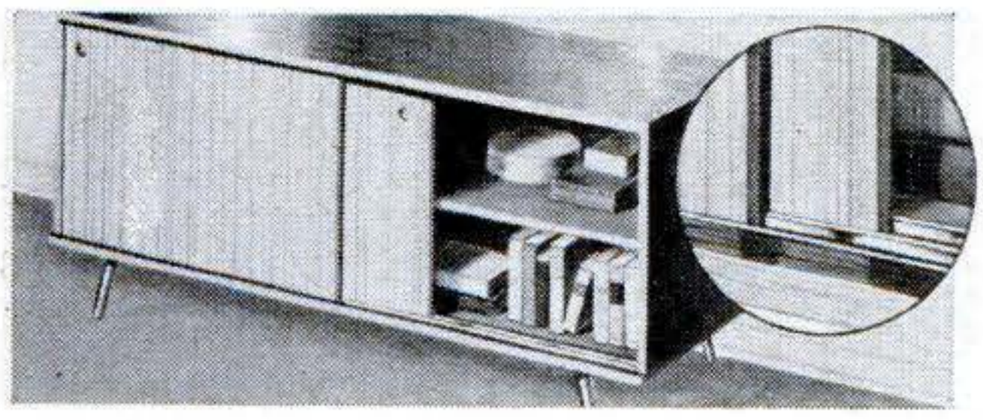

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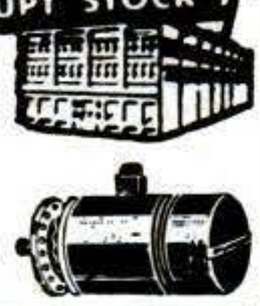

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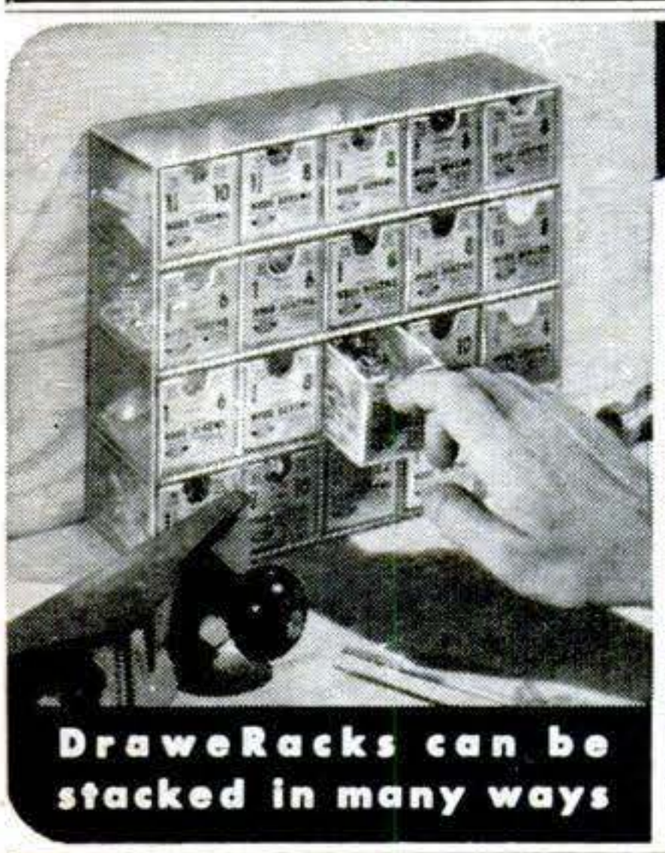

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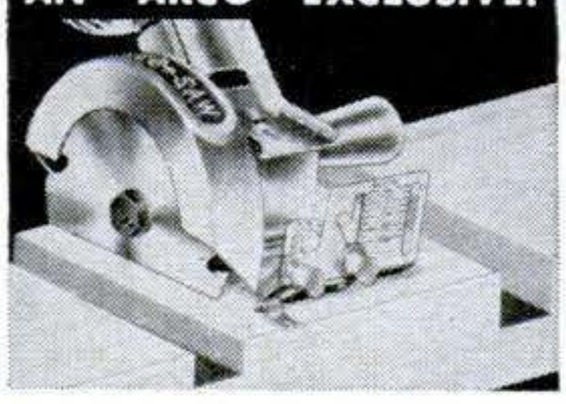

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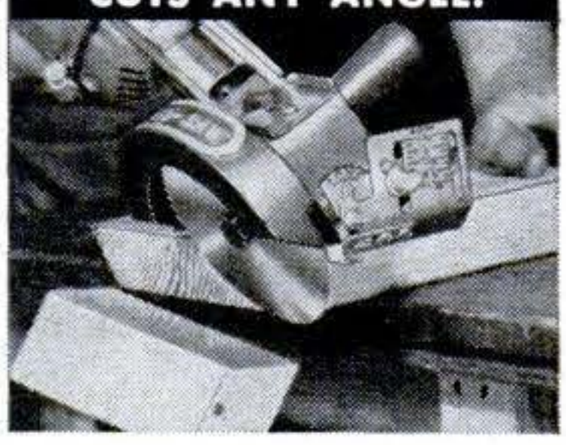

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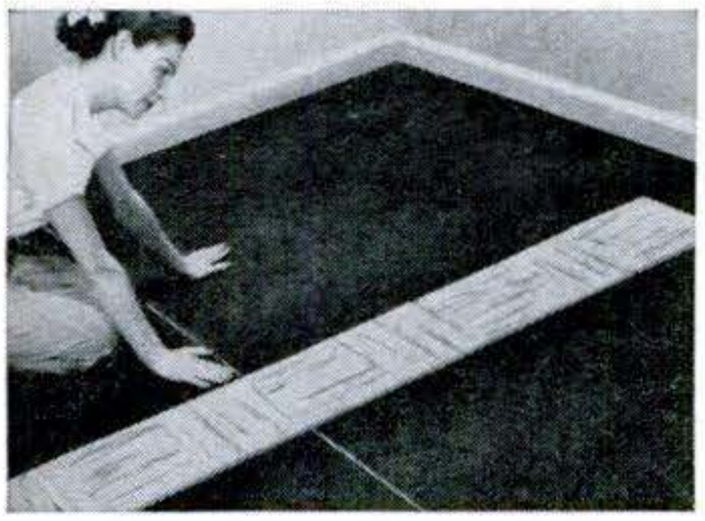
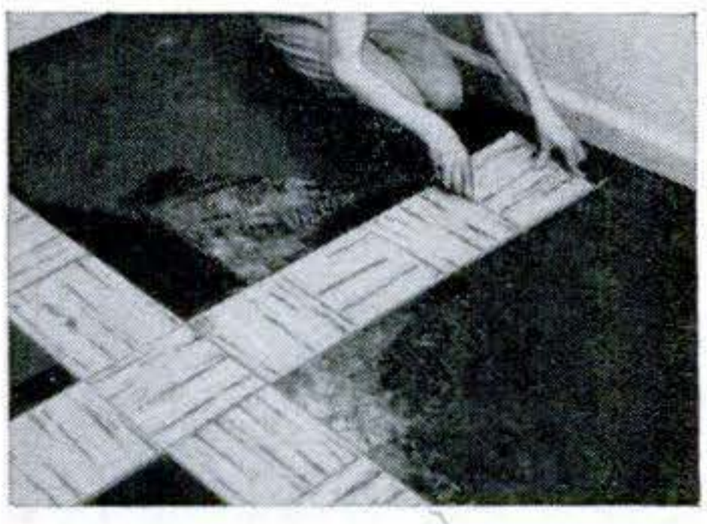
1. Measure and mark center points of two facing walls, disregarding bays, alcoves, etc. Snap a chalk line between these marks. Mark another line at right angles to this line through its exact center. Put an uncemented tile in one corner of the crossing chalk lines.



2. Work from center tile, laying a row of uncemented tile from wall to wall. If border is less than half a tile, take up one tile from opposite end of row and move the row away from wall half a tile. This will cover the other chalk line, so snap a new line, parallel to and one half a tile from the covered line.



3. Spread a 1½ ft. path of adhesive along one side of your two center chalk lines. Resnap chalk line wherever adhesive may cover it. (Use easy-to-apply Milmark Roll-On Adhesive.) Let adhesive "set" (get tacky). Lay tile on adhesive along both chalk lines, wall to wall, but not in border areas.

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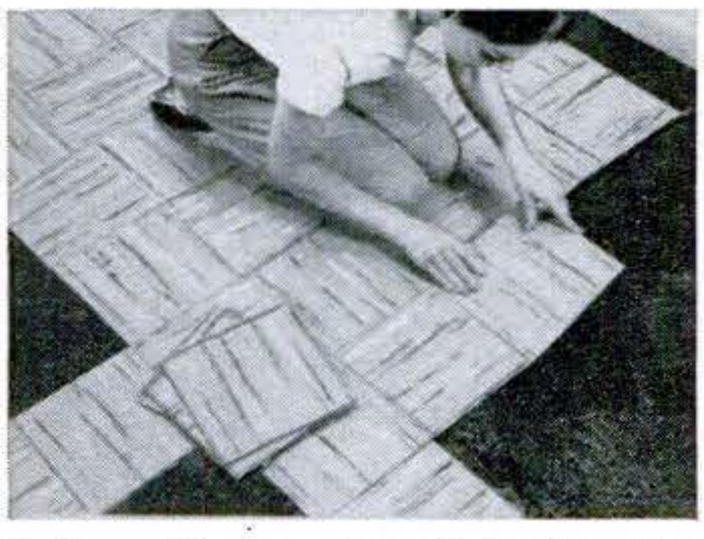
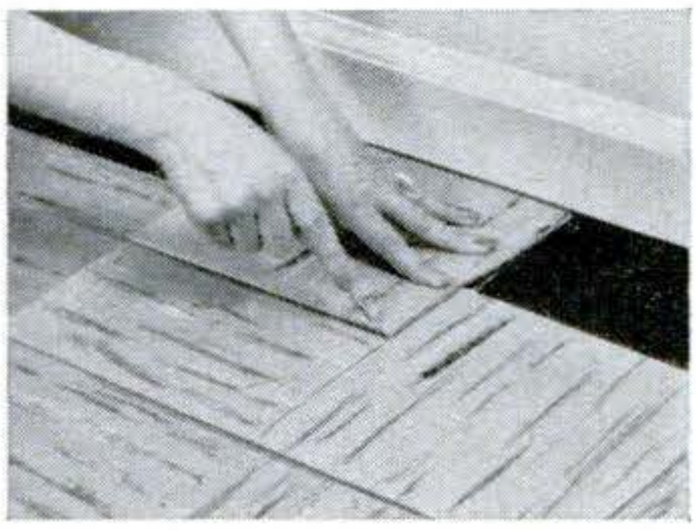
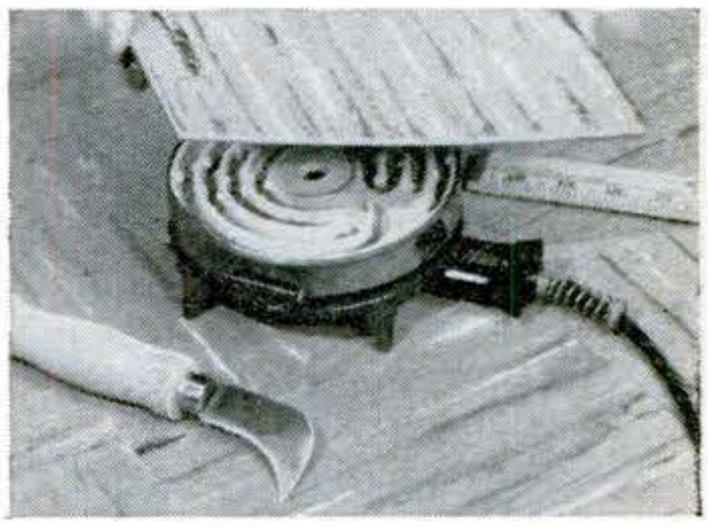
HC25



4. Cement two quarters of room (exclude border space). When adhesive "sets", lay tile, working away from center. Do not slide tile into position; place and press down. Cement third quarter before tiling second quarter and so on.



5. To mark border tile, place loose tile over last row of cemented tile. Place another tile on top of loose tile. Using top tile as a rule, mark tile underneath for cutting. Mark enough tile for one wall at a time. Then cut.



6. To cut tile, first heat back of tile over hot plate, gas burner, etc. Cut tile with sharp hook knife. (Hako Vinyl-Plastic Tile can be cut with household shears.) Spread adhesive in border area and place tile in position.

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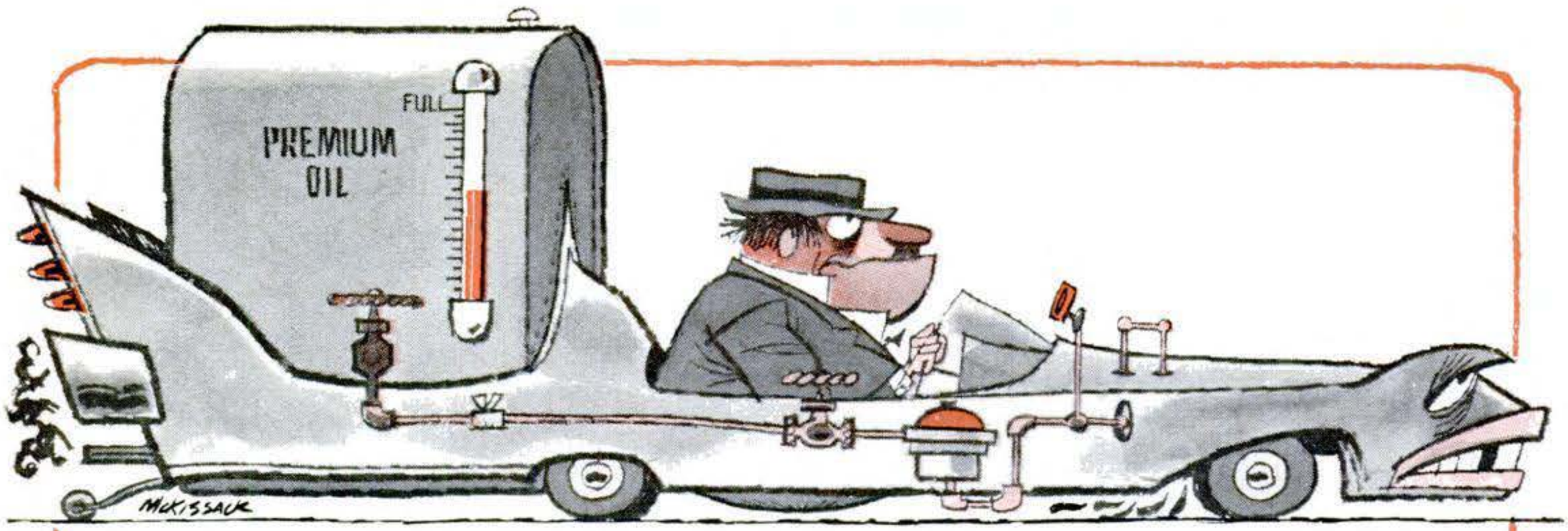

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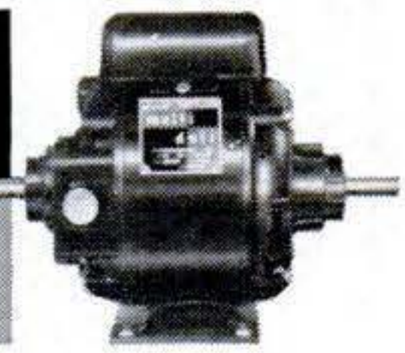

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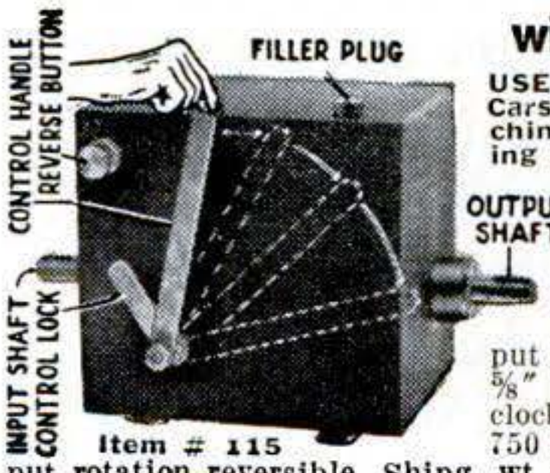

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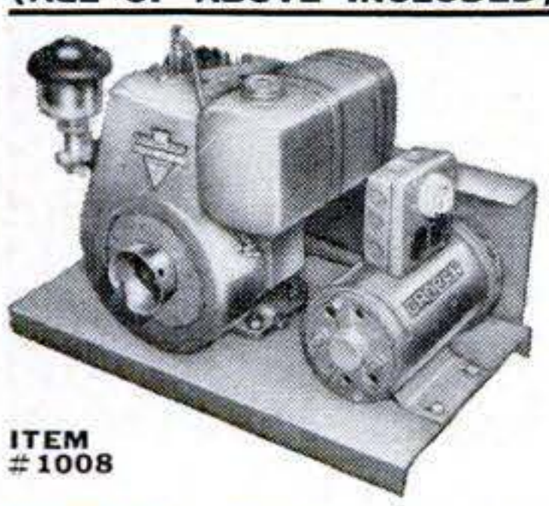

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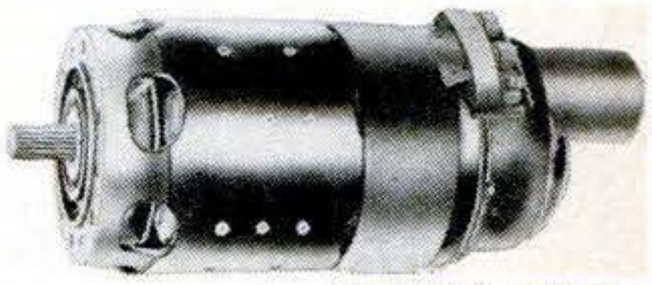

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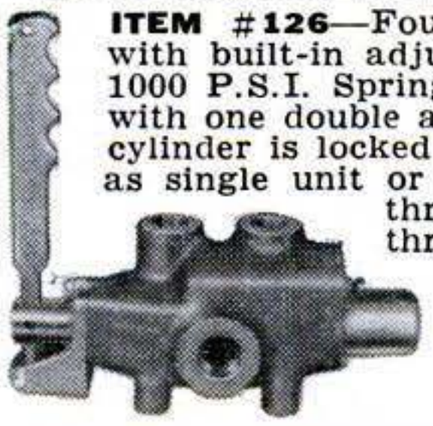

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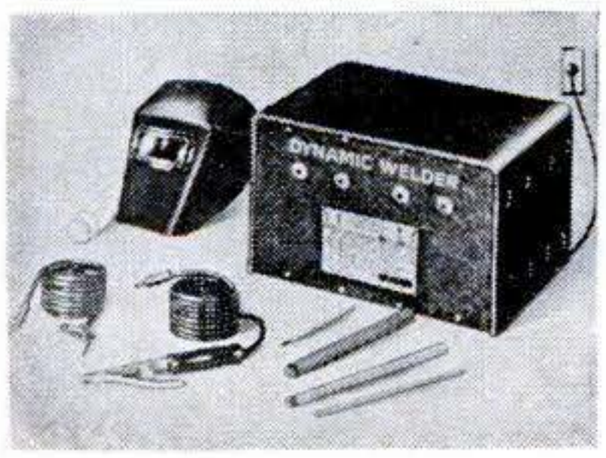

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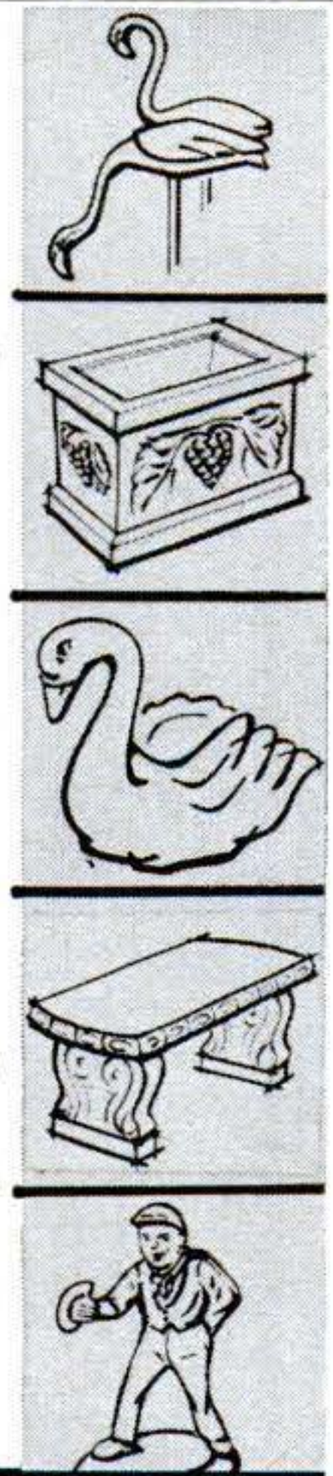

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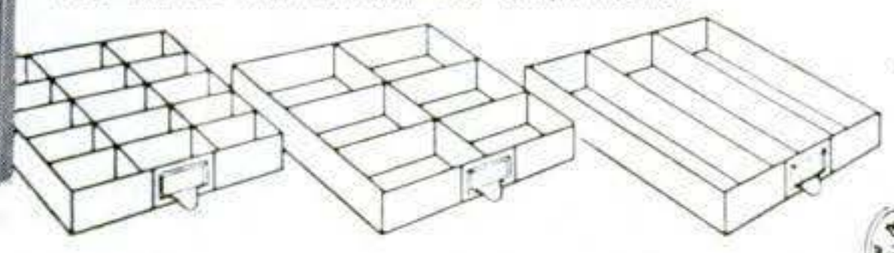

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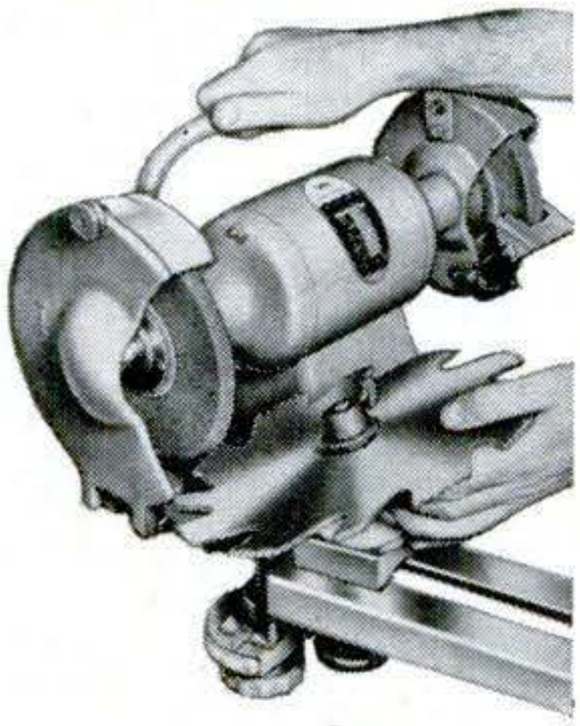

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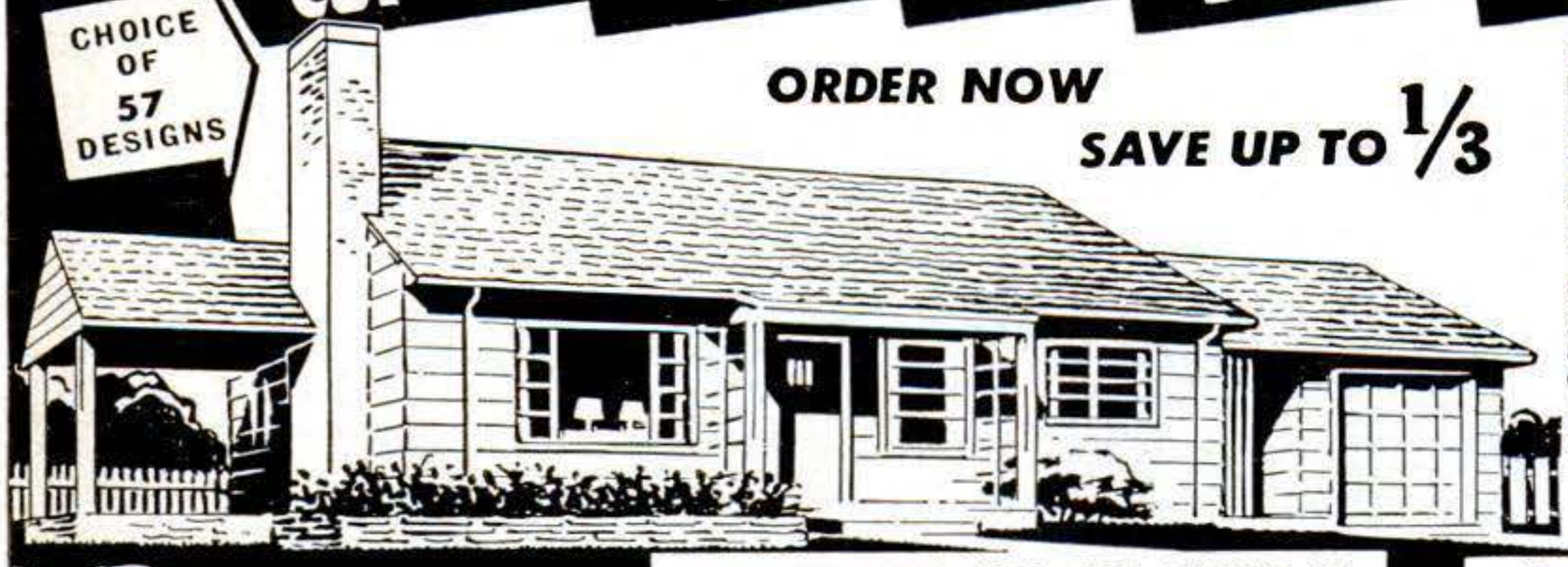

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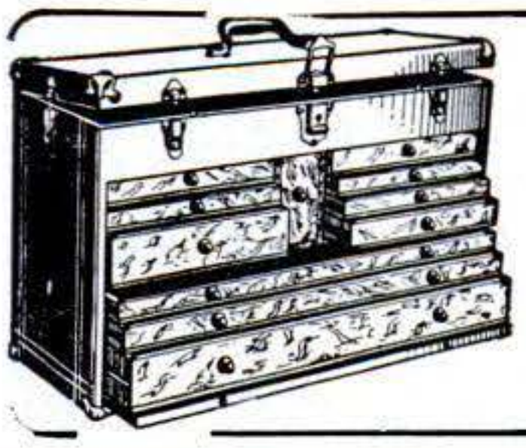

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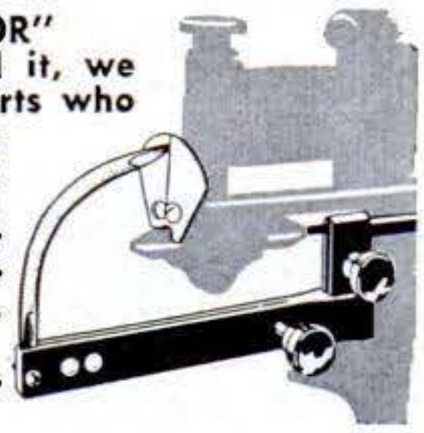

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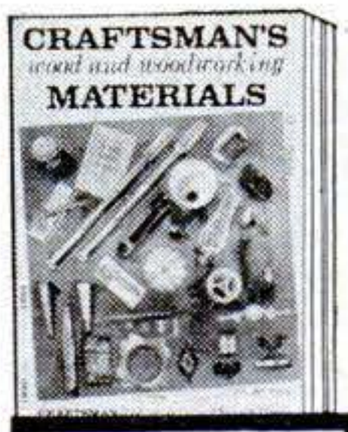

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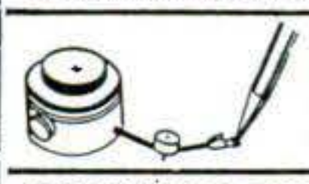

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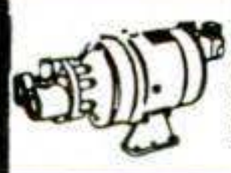

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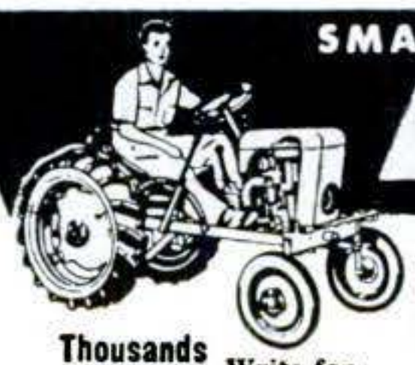

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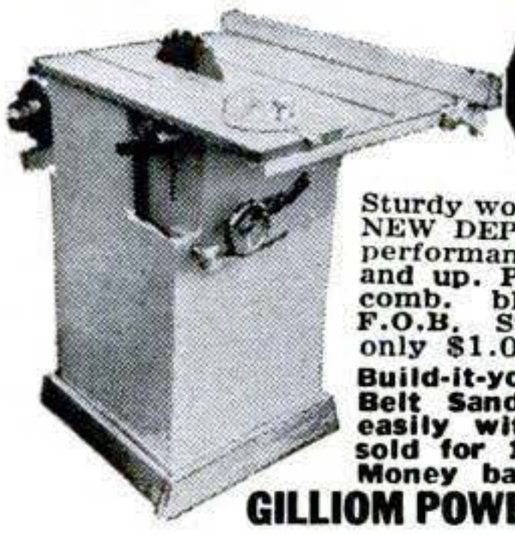

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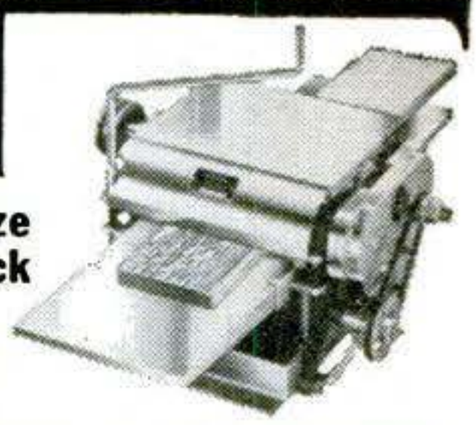

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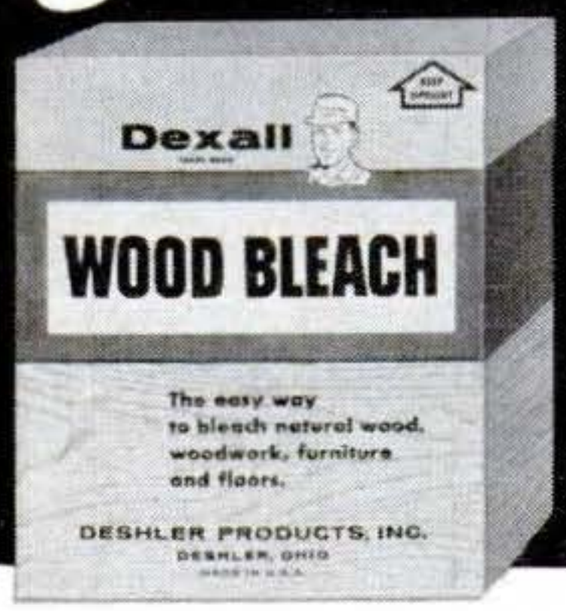

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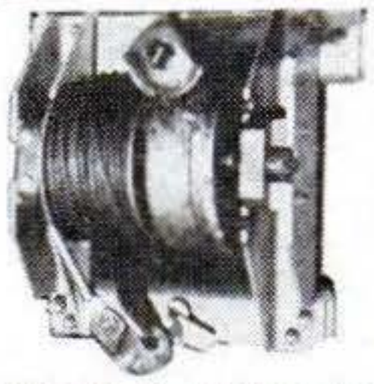

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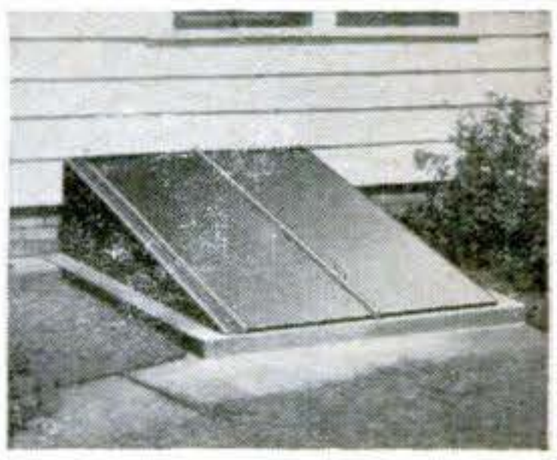

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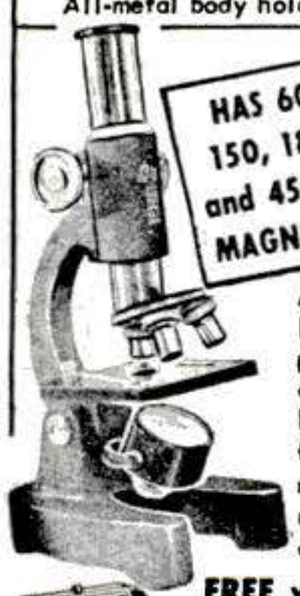

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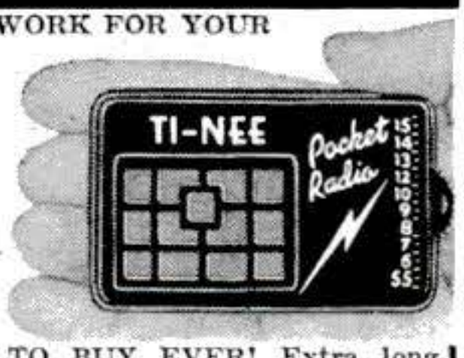

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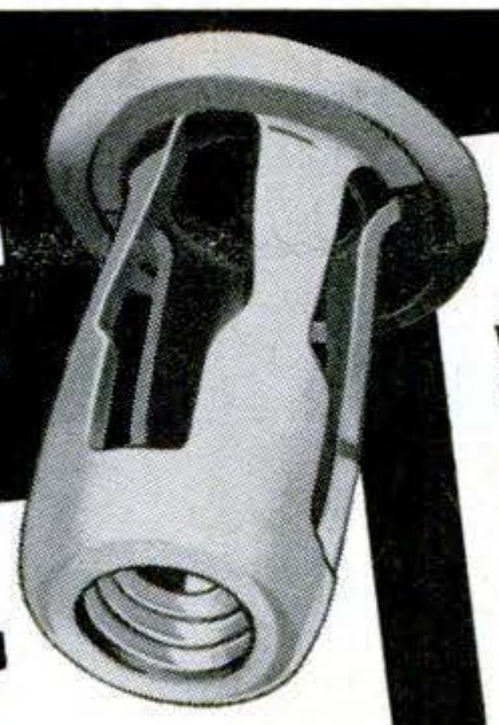

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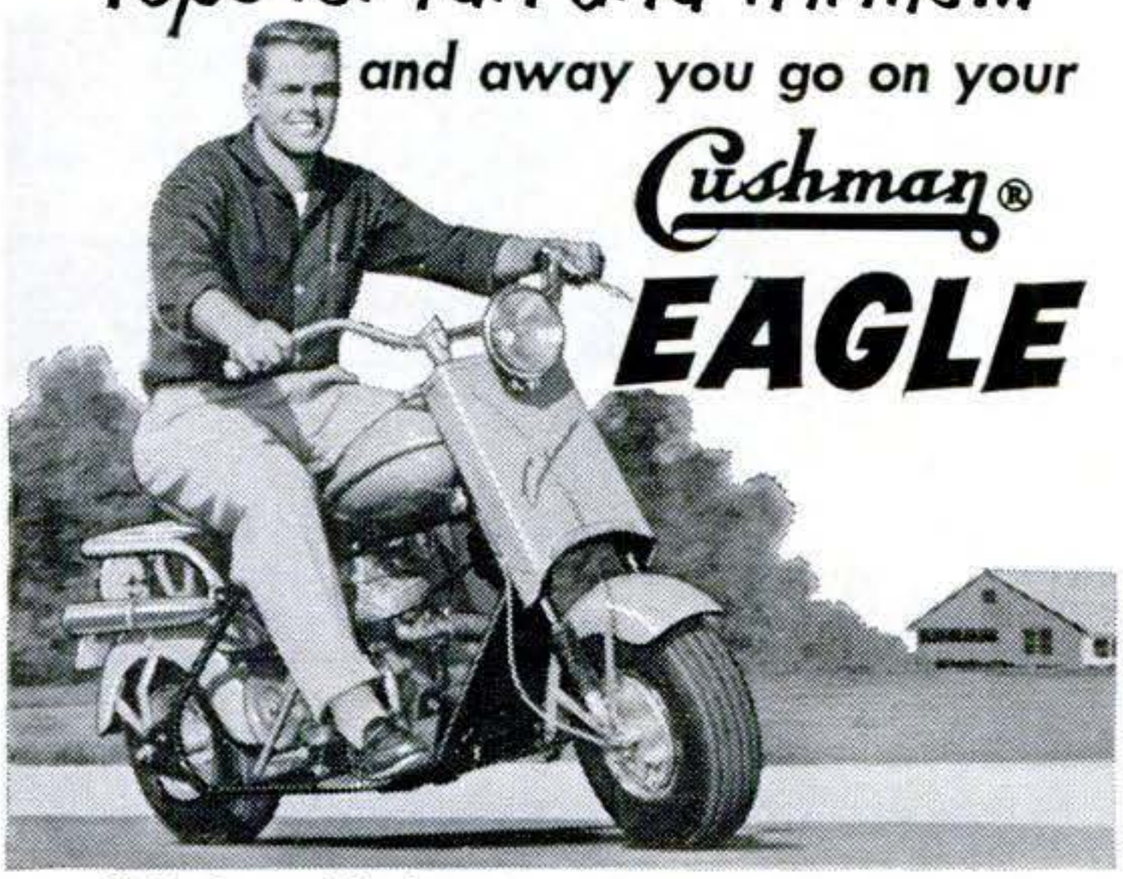

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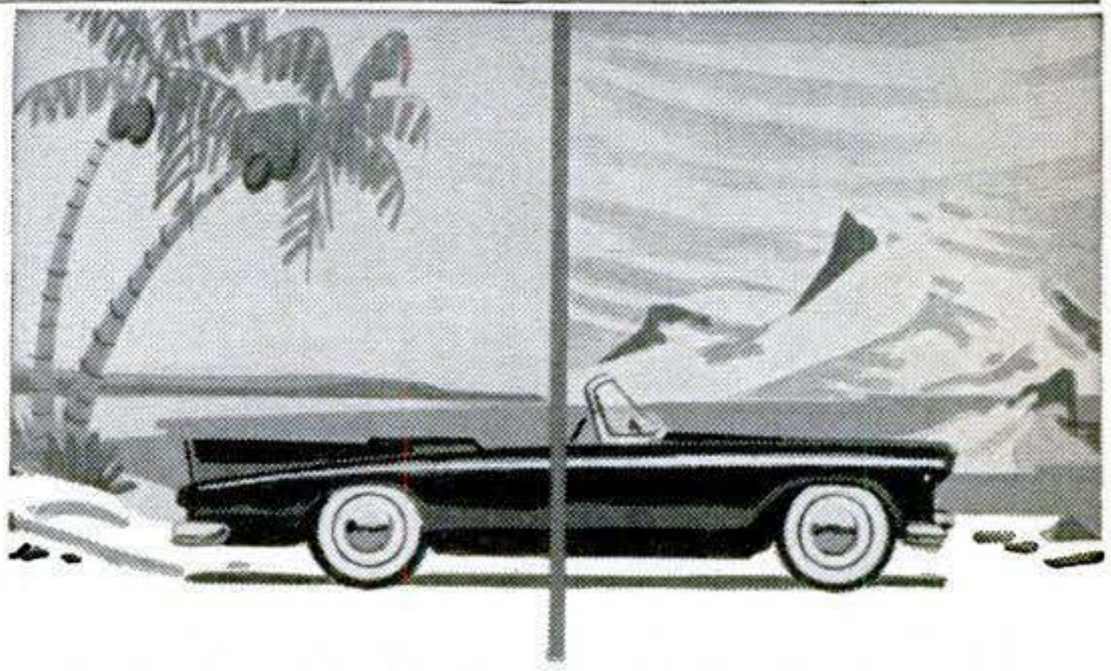

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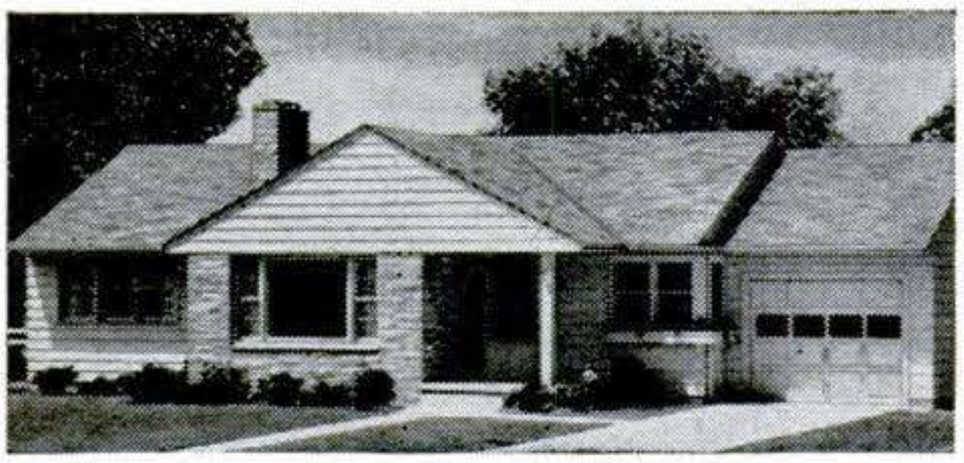

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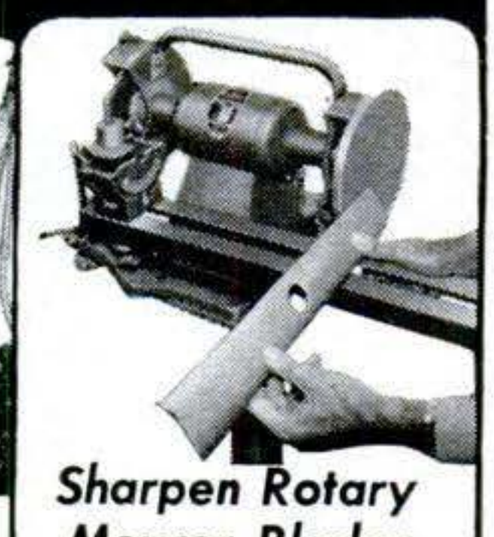

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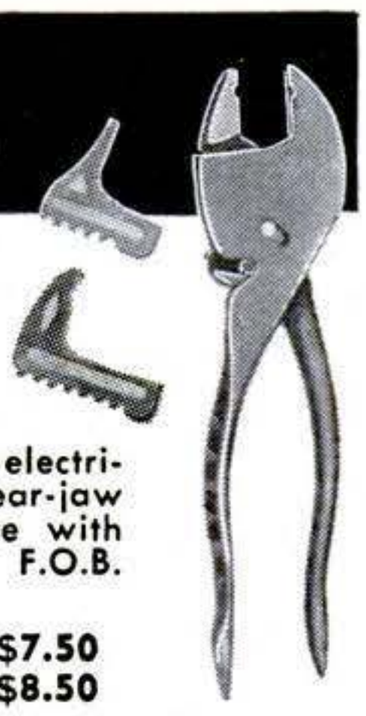

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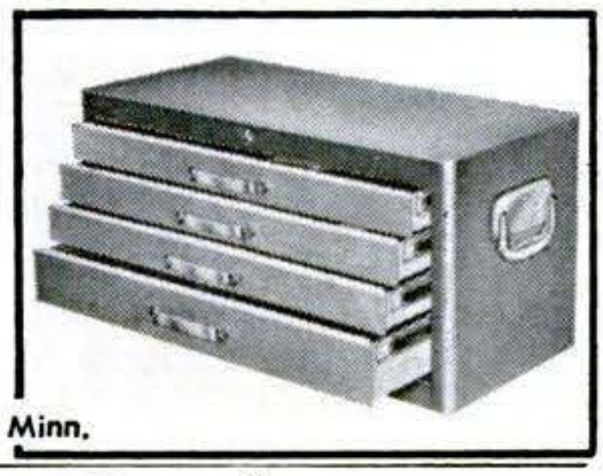

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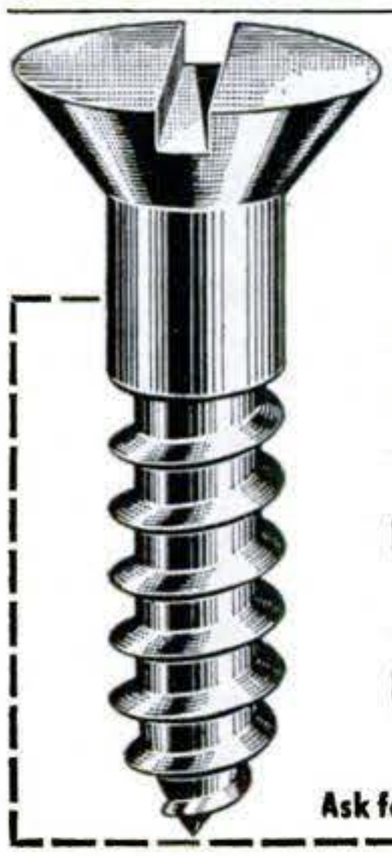

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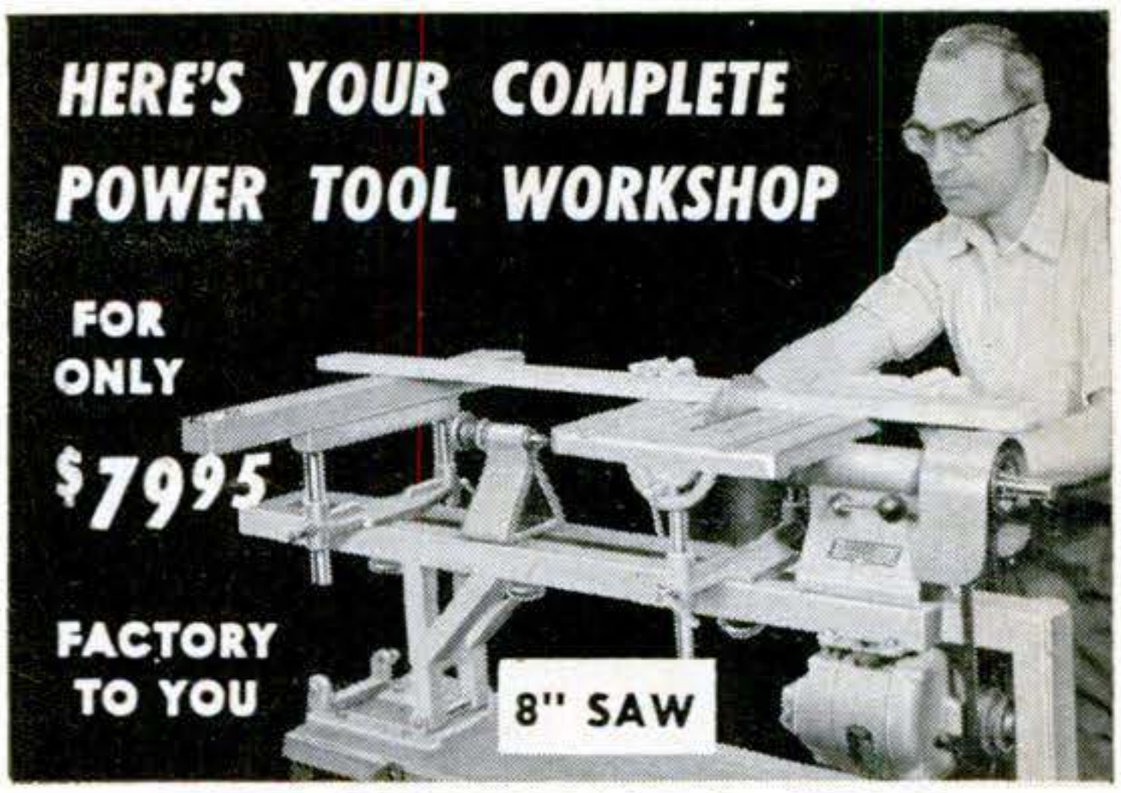

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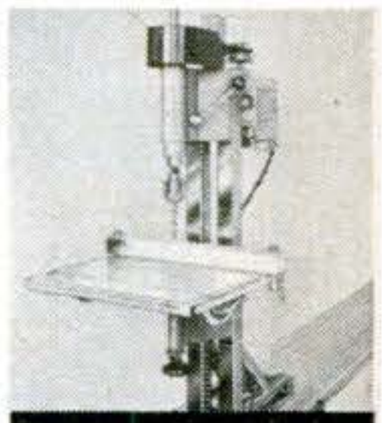

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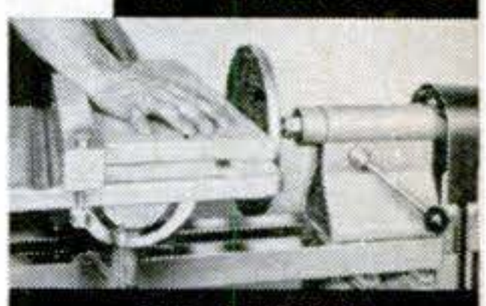

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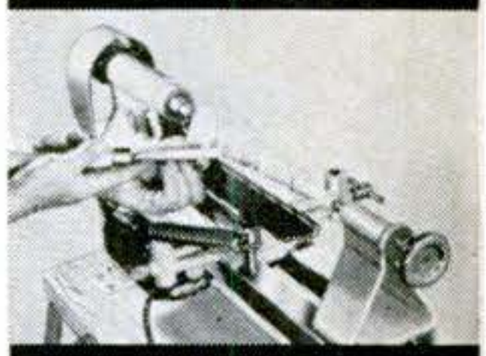

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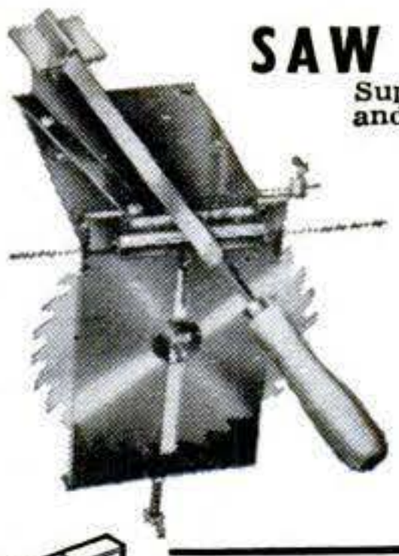

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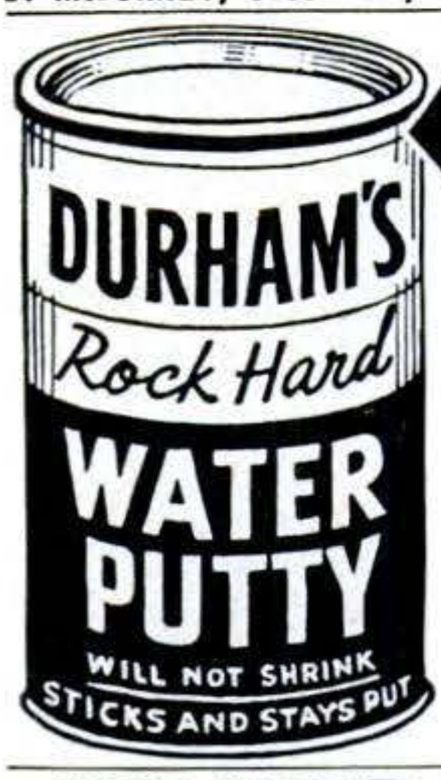

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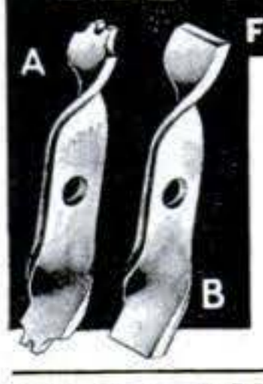

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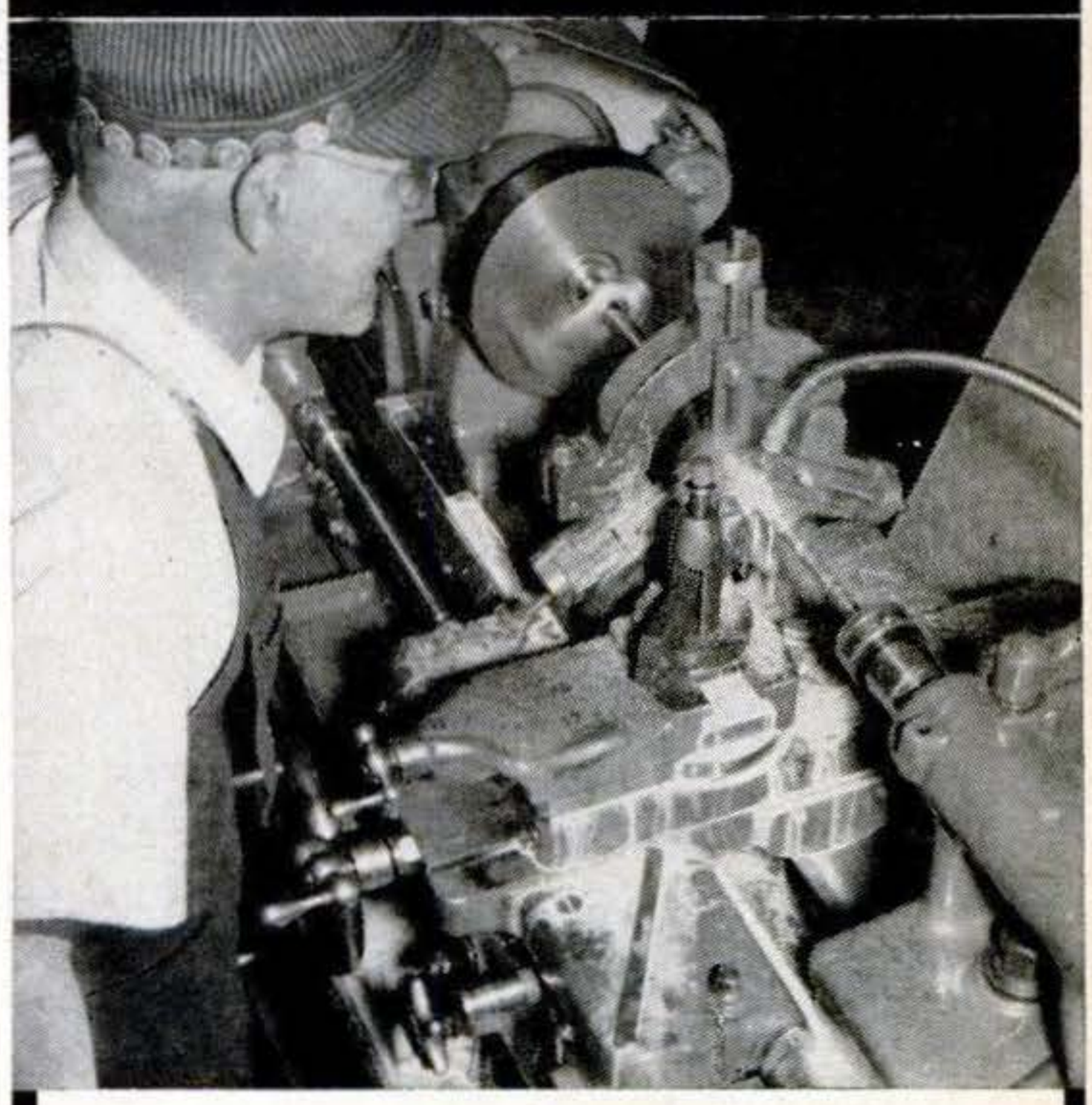

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- Rugged, rigid construction that will stand up under hard usage.
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SPECIFICATIONS	13"	14½"
Swing over cross slide	7¾"	8¾"
Maximum collet capacity	1 1/16"	1 1/16"
Spindle speed range	20-940	15-875
Shipping weight, 7' bed	1760 lbs.	2089 lbs.
Base price	$1675	$2074

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Builders of Lathes, Milling Machines, Shapers, Drill Presses, Pedestal Grinders

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[Continued from page 129]

an experienced teacher, with a passion to impart, drags or even tricks the student into comprehension."

Of course, impassioned teachers are rare in *any* kind of school. The correspondence people make a real effort to keep students interested, peppering them with brochures, newsletters, pep talks, as well as long personal letters and handwritten comments on exams.

With every lesson comes the examination, which looks like the tests you'd get in any other school. One difference: It's "open-book." You are encouraged to refer to the lesson while doing the exam.

Check a sample examination critically. It's one clue to the quality of the course. Ask yourself these questions:

- Will you have to understand the lesson thoroughly to complete it? Or is it nothing but a copying exercise?
- Will your answers have to be graded by a qualified instructor? Or could that job be done by a clerk?
- Does the examination help you learn more (by clarifying and emphasizing important points)? Or does it simply test what you have already learned?

Some schools use true-false or check-the-right-answer tests. Most often, though, you will have to solve problems and write out essay answers.

Who are the instructors? In ICS' Big Red Schoolhouse—and most other schools that teach a variety of subjects—they're women. They are high-school graduates who learn a subject by studying the same lessons you do. (This is not much different from the standard university practice of employing graduate students to correct undergraduate papers.) Some of them have spent 20 years or more on the job and have become highly expert in their particular fields, despite a frequent lack of practical experience in the work. Directing the instructors are several echelons of supervisors, many with outside experience both as teachers and as workers in the field they teach.

It's different at some of the bigger schools specializing in very technical subjects—electronics, particularly. There, every exam is corrected by a man who has both theoretical and practical knowledge in the field.

Some other unusual features of the ICS system stand out. Two examples:

- Your mistakes in grammar and spelling are meticulously corrected, no matter what course you are studying.
- You can't fail an exam. The worst grade is W—withheld. The exam is sent back for you to do over. There's no limit to the number of times this can happen; you just keep trying until you pass. Otherwise, ICS' grading is tough—you have to score 95 percent to rate an A, and at least 75 percent for a C, the lowest passing grade.

In some radio-TV schools, not only can you fail an exam, you can flunk out completely. Early in the course there is a point of no return. If you consistently fail the tests at that stage, you'll get a polite letter suggesting that you are not cut out for a career in TV repair. Usually your money will be refunded.

It's an honest man who will go through a dozen snapshots of himself without feeling the urge to tear up at least one.
—THE SIDEWALK SUPERINTENDENT

Who gets the diploma? If what we have said makes correspondence study seem like work, that's intentional. You'll have to devote the equivalent of an hour or two almost every night of the week, for a year or more, to get anywhere with a worthwhile course.

That's not easy for a young man with a family and a full-time job. Only one in five sticks it out to the end. (The attrition rate at regular colleges is somewhat better; about half of those who start graduate.)

But the rewards—that better job, more money—are there. Correspondence training is a popular and effective route ahead in such attractive fields as accounting, engineering, drafting, TV repair (one fourth of all Certified Public Accountants are the product of home study).

The number of students has doubled in the past decade, and will almost certainly double again in the next. This growth comes none too soon. In the titanic struggle for world leadership, America's greatest weapon is trained men—which are exactly what correspondence schools can produce. END

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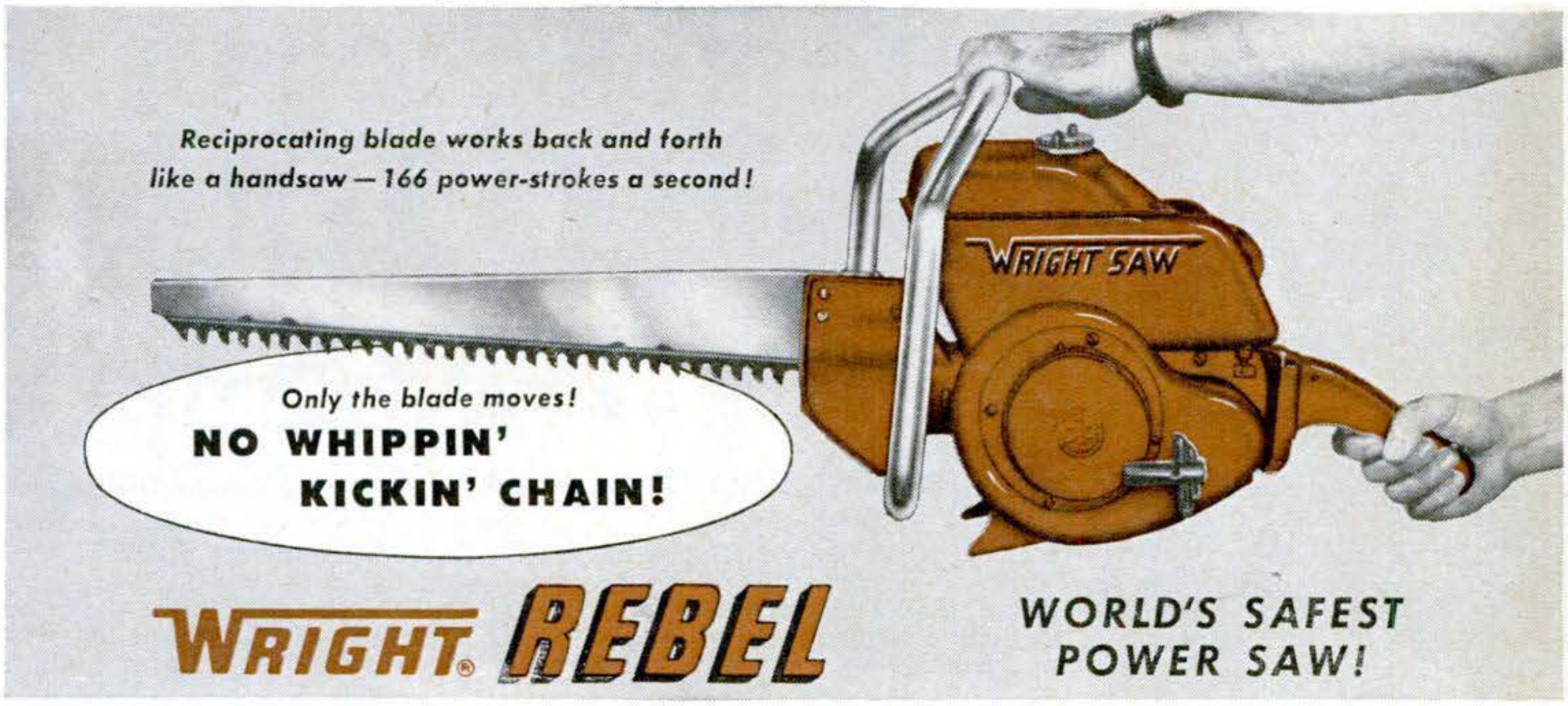

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Women or youngsters can do it! Neither strength nor skill is required to handle the lightweight, super-safe Wright *Rebel*. Smooth, self-feeding cutting action —with no whip, kick or grab!

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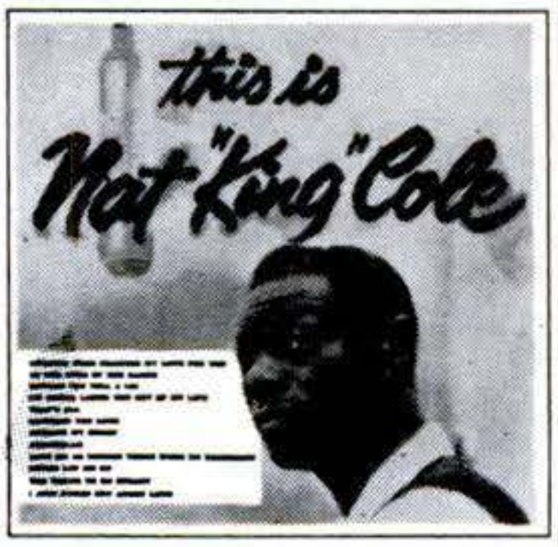

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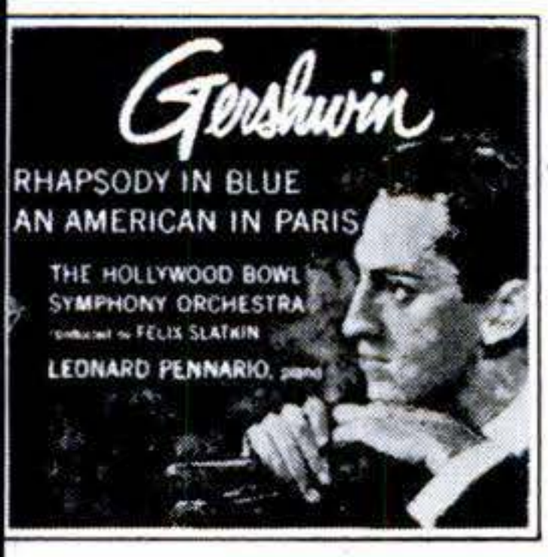

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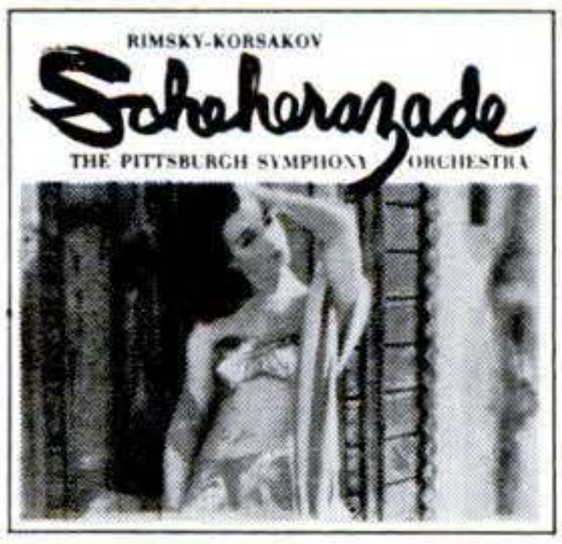

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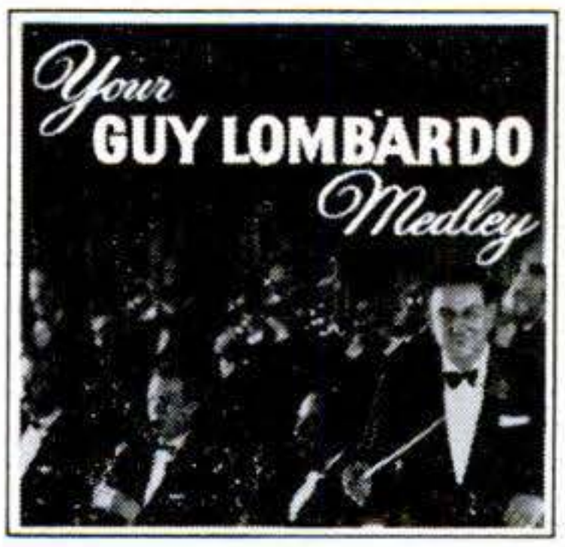

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